Monotonicity in Opaque Verbs

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0. Quantification vs. Predication

In this paper I will defend a quantificational semantic analysis of the unspecific readings of *opaque* transitive verbs, i.e. verbs that induce a certain kind of ambiguity with respect to their direct object position:[1]

(0a) I owe you a horse.
(0b) Ernest is looking for a lion.
(0c) Tom's horse resembles a unicorn.
(0d) John hired an assistent.

Unlike sentences with ordinary, *transparent* verbs and indefinite objects, each of (0a–d) allows for a reading that cannot be described in terms of existential quantification over the individuals in the extension of the respective noun. Rather, it seems as though the domain of quantification is shifted, as the following naive paraphrases (of the relevant readings) indicate:

(0'a) I owe you an <u>arbitrary</u> horse.
(0'b) Ernest is looking for an <u>intentional</u> lion.
(0'c) Tom's horse resembles a <u>generic</u> unicorn.
(0'd) John hired a <u>would-be</u> assistent.

Neither arbitrary horses, nor intentional lions, nor generic unicorns are animals, and would-be assistents do not have to be assistents.[2] In fact, one may well wonder just what sort of objects the paraphrases in (0') are supposed to be about. Given their dubious ontological status, an analysis of (0) that can do without them ought to be preferrable to one along the lines of (0') – *ceteris paribus*. Such analyses have been developed, based on the observation[3] that opaque verbs tend to express propositional attitudes (in a broad sense). Following them, instead of trying to make literal sense of (0'), it is more worthwhile to explore the (admittedly rough) paraphrases under (0") instead, thereby reducing the strangeness of (0) to an interaction of the lexical meaning of the opaque verb and the ordinary meaning of the indefinite as existentially quantifying over the extension of its head noun:[4]

(0"a) I am obliged to see to it that it will be the case that I give you <u>a horse</u>.
(0"b) Jones is trying for it to be the case that Jones finds <u>a lion</u>.
(0"c) Given its outward appearance, Tom's horse could be <u>a unicorn</u>.
(0"d) Jones saw to it that someone would be <u>an assistant</u>.

And semantic analysis does not have to stop here. Since the (underlined) objects of (0) seem to have their ordinary meanings in the paraphrases (0"), it is this meaning that they contribute to the the original sentences. Hence an opaque verb may be described as connecting the referent of its subject to this meaning – the sense of an existential quantifier, or maybe the property expressed by a noun.[5] Following this strategy of analysis, then, (0) does not come out as a

[1] The sources of the examples (0a), (0c), and (0d) are, respectively: Buridanus (1977: 83), written in the 14th century and apparently the first discussion of opacity; Zimmermann (1993: 158); and Moltmann (1997:12). (0b) is concocted from Quine (1956: 177; 1960: 152), the first modern account of the phenomenon; Quine's original examples involve complications that would lead astray here.

[2] There is an asymmetry between (0d) and the other sentences under (0), and thus between would-be assistents and the other outlandish objects quantfied over in (0): while (0d) implies that there be a specific individual – though not (necessarily) an assistent – that John hired, no such conclusion to specificity can be drawn from any of (0a) – (0c). In a sense, (0d) is specific (with respect to the person hired) and unspecific (with respect to assistenthood) at the same time. It seems to me that this is typical of verbs of creation (among which I would consequently count *hire*); but I will leave this highly controversial issue for another ocaasion.

[3] Quine (1956).

[4] Paraphrases similar to (0"a) – (0"c) have been provided by Montague (1969: 175f.), Quine (1956: 178), Schwarzschild (p.c., 2000), respectively. (0"d) is in the spirit of an analysis of verbs of creation Arnim von Stechow (p.c., 1991) once proposed; cf. von Stechow (2001: 309ff.).

case of *quantification*, as (0') would suggest, but rather as a form of *predication*. More precisely, the function of the opaque object would not be to quantify over strange things standing in a strange relation to the referent of the subject, but to denote a certain sense that contributes to a proposition to which the referent of the subject bears a certain attitude determined by the verb. One objective of the present paper is to show that the predication analysis of opacity, in both its variants (quantifiers or properties) encounters a serious, possibly unsurmountable problem that can be avoided by a careful formulation of a quantificational analysis restoring the intuition underlying (0').

In Section 1, I will discuss a seemingly straightforward inference pattern (M↑) involving *seek* (or, rather, its more colloquial synonym *be looking for*) and relate it to various versions of the classical Montagovian analysis of opacity. In Section 2, I will show that the most obvious account of (M↑) has a problem with the *underspecific* readings arising with certain objects of opaque verbs: the *Monotonicity Problem*. In Section 3, I show how (M↑) can be obtained by supplying underspecific readings for all objects within a property-based approach to opacity using type coercion; as it turns out, the approach avoids the Monotonicity Problem. Sections 4 and 5 address remaining issues including specific readings, definite objects, bare plurals, and verbs of non-existence (like *avoid*).

1. Monotonicity Inferences

1.1 Inference Patterns

Consider the following inference:

(1) Jones is looking for a green sweater.
∴ Jones is looking for a sweater.

The premiss of (1) may be construed as reporting that Jones is looking for a particular sweater, e.g., the one that he had bought for his son's birthday and that he had hidden somewhere in his wardrobe. Given this *specific* construal, the inference is certainly valid, provided that the conclusion is read in an analogous way: if the premiss is true, it is testified by a green sweater which, *qua* sweater, also testifies the conclusion, again on a specific construal. Hence, given a specific construal of both premiss and conclusion, (1) instantiates a familiar pattern of *Existential Weakening* and is therefore akin to:

(2) Jones is wearing a green sweater.
∴ Jones is wearing a sweater.

On the specific construal, the premiss in (1) does not fully specify any particular sweater that Jones is looking for; neither does the premiss in (2) fully specify the sweater he is wearing. Whether or not the speaker is in a position to give such a specification, (s)he does not do so when uttering either of these sentences. However, whether or not the speaker has a particular sweater in mind, the sweater testifying the truth of either of the sentences in (2) would have to be a particular, specific object – as it would have to be for the truth of (1) on the relevant, specific construal. The specificity exemplified by one reading of (1) and the only reading of (2), then, is a semantic property that must not be confused with a pragmatic notion of specification or speaker's reference: the premisses and the conclusions are *specific* in that their truth depends on certain relations holding between Jones and (at least) one specific, though unspecified, object; they are *not specificational* in that neither gives a (full) specification of any such object. In what follows the term *specificity* will always be used in this semantic sense; and we will return to the distinction between unspecificity and non-specification in Section 2.

Neither the premiss nor the conclusion of (1) need to be read specifically; they also allow for an *unspecific* construal. This difference is due to the peculiar nature of the verb *seek*, which, unlike the majority of transitive verbs, allows for an unspecific reading. I will refer to verbs like *seek* as *opaque* verbs. According to the unspecific reading of the premiss in (1), Jones would

5 This idea was first expressed in Montague (1969: 176f.), where it is also pointed out that the resulting analysis does not depend on the paraphrase. The variant that trades in quantifier senses for properties has been proposed in Zimmermann (1993).

not have to be looking for any sweater in particular, e.g. when he is entering a shop to buy a present for his son's birthday. Is (1) a valid inference, given the unspecific construal of its premiss? It seems so, provided that the conclusion is read unspecifically too: once the truth of the unspecific reading of the premiss of (1) has been established, denying its conclusion appears utterly incoherent. However, this time Existential Weakening cannot be the explanation: the premiss does not seem to have any existential force. Hence another logical principle is responsible for the inference or, alternatively, it falls out of general principles of assertability.[6] In any case, it is clear that (1) instantiates a general pattern, be it of a semantic or of a pragmatic nature. The pattern is given in (M↑), where P is a less general term than Q, which I have expressed as a bracketed side-condition:

(M↑) x is looking for a P. $[P \sqsubseteq Q]$
∴ x is looking for a Q.

(M↑) is subject to a certain amount of vagueness due to the fact that the very notion of *being less general* does not have sharp boundaries. The idea is that $P \sqsubseteq Q$ holds if it is analytic that the extension of P is a subset of the extension of Q. General worries about analycity notwithstanding, (1) illustrates that there are perfectly clear cases and I will only be concerned with them.

(M↑) is to be understood as involving the unspecific readings of premiss and conclusion. The Existential Weakening of the specific reading of the premiss will be of no concern to us here, and mixed construals – where one of the sentences is read specifically and the other one is unspecific – are obviously invalid anyway.[7] For the rest of this paper, I will assume that (1) is correct, at least in the sense that whenever the premiss can be used to say something true, then so can be the conclusion. This might be due to a semantic entailment between (the unspecific readings of) the two sentences; but then again it might also be due to pragmatic factors. Both options will be discussed in due course.

It may be noted in passing that the inference in (1) cannot be reversed: Jones may be looking for a sweater to give to his son without being biased as to its particular colour. Hence the corresponding pattern (M↓) must be invalid – an observation that will become important in a moment:

(M↓) x is looking for a Q. $[P \sqsubseteq Q]$
∴ x is looking for a P.

1.2 Logical Analysis

Any study of the nature of the inference (M↑) must rest on some semantic account of *seek*. My starting point will be the classical Montagovian approach, according to which (transitive) opaque verbs express relations between individuals and quantifiers.[8] This analysis, familiarity with which I will assume, may be motivated in terms of Quinean paraphrases[9], and I will occasionally rely on corresponding lexical decompositions. (3) is a case in point:[10]

6 What I have in mind here is a roughly Gricean or Stalnakerian distinction between semantically based inferences that reflect implications between propositions expressed, and pragmatically based inferences that are drawn assuming the reliability of the speaker and other properties of appropriate utterances. The exact nature of this distinction, as studied in Grice (1989) and Stalnaker (1999), is largely irrelevant to my present concerns.

7 Cf. Montague (1970: 394). According to Forbes (2003: 53), there must also be a *neutral* reading that truth-conditionally boils down to the disjunction of specific and unspecific construal. I will ignore this possibility throughout this paper.

8 Montague (1969; 1970; 1973).

9 Cf. Section 1.3 of Zimmermann (to appear) for the relation to the paraphrases given in Quine (1956) and Quine (1960: 151ff.) which, incidentally, involve *strive* and *endeavour* instead of *try*.

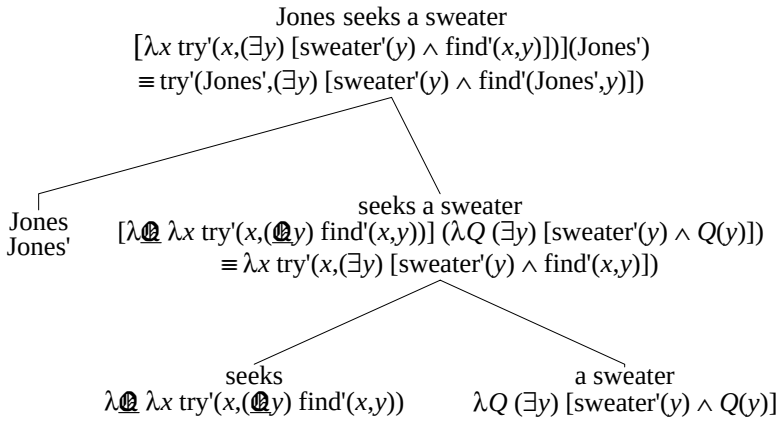
10 In the following I am using a one-layered semantics with sentences expressing propositions (= functions from world-time pairs to truth values), whose type is t. In type-logical notation, the denotation of *seek* will thus be of type $((et)t)(et)$. Given this set-up, a *property* is a funtion (of a type at), whose *extension* is the set of objects (of type a) to which P assigns a true proposition. Non-obvious notational conventions are as follows: unless otherwise specified (as, e.g. in (3) below), primed English words are non-logical constants; simultaneous application to a sequence of arguments indicates suc-

(3) seek' = $\lambda \textcircled{12}\ \lambda x\ \mathrm{try}'(x,(\textcircled{12} y)\ \mathrm{find}'(x,y))$

Though such decompositions oversimplify matters[11] and are not strictly essential for the discussion below, I think that they are helpful in gaining a better understanding of what is going on.

Analyzing opaque verbs as attitudes towards quantifiers immediately accounts for the unspecific reading of the conclusion in (1), provided that the indefinite object expresses a restricted existential quantifier and is combined with the verb by functional application:

(4)



Unspecific objects, then, are – usually existential – quantifiers, and unspecificity comes out as scopally dependent quantification: the sense in which Jones seeks an unspecific sweater according to (4) is the same in which an unspecific woman may be loved by every man if (5) is true on a narrow scope reading of the quantified object:

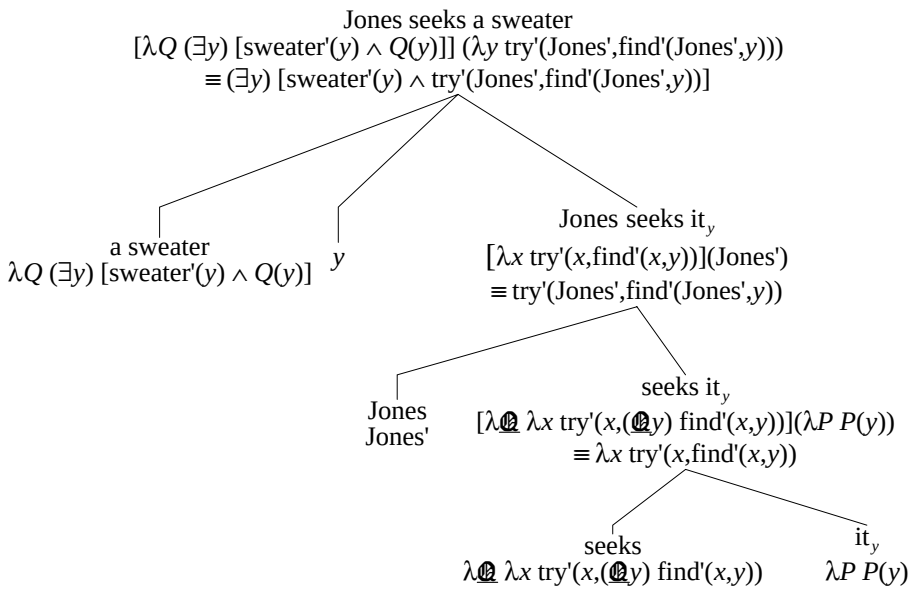
(5) Every man loves a woman.

In order to also obtain a specific reading, a certain amount of rebracketing is necessary. Montague's classical implementation, which I will adopt here, makes use of a logical form involving *quantifier raising* (a.k.a. *quantifying in*):

cessive application in the reverse order ('Currying'); a variable bound by a quantifier abbreviates a λ-bound variable in its argument; the equality symbol '=' may flank formulae of arbitrary types and expresses sameness of denotation, not extension.

11 The notorious lack of fine-grainedness of possible worlds semantics may be one such oversimplification. More to the point, (a) the attitude occurring in (3) need not be the one expressed by the English verb *try*, and (b) it ought to be *de se* rather than propositional; also, (c) the unspecific object may in general be of a relational nature. See (a) Larson *et al.* (1999), (b) Lewis (1979a), and (c) Burton (1995) for some pertinent discussion. Another simplification – the omission of eventuality parameters – will be addressed in due course.

(6)



Specificity thus comes out as quantification into *singular* attitudes whose objects involve particular individuals. Though this in itself is known to be problematic,[12] the intricacies of *de re* attitudes appear to be largely independent of the present considerations, which is why I will content myself with the simple construal given in (6).

1.3 Lexical Analysis

The analysis of unspecific objects as quantifiers by itself does not bear on the inference patterns (M↑) and (M↓). On the other hand, the obvious way to establish (M↑) as a semantic entailment is to restrict the interpretation of *seek* by imposing a corresponding condition on admissible models. Since indefinites in the scheme denote existential quantifiers $\exists_P$ restricted by properties P, the following *monotonicity postulate* does the job:[13]

($\Uparrow_S$) $\Box\ (\forall x)\ (\forall P)\ (\forall Q)[P \sqsubseteq Q \rightarrow\ [\text{seek}'(x,\exists_P) \rightarrow \text{seek}'(x,\exists_Q)]]$

– which, given the decomposition (3), boils down to:

($\Uparrow_{TF}$) $\Box\ (\forall x)\ (\forall P)\ (\forall Q)[P \sqsubseteq Q \rightarrow$
$[\text{try}'(x, (\exists y)\ [P(x) \wedge \text{find}'(x,y)]) \rightarrow \text{try}'(x, (\exists y)\ [Q(x) \wedge \text{find}'(x,y)])]]$

Rather than stipulating ($\Uparrow_S$) or ($\Uparrow_{TF}$) as deductive principles, one should, and indeed may, obtain them as consequences of a more thorough, truth-conditional analysis. More specifically, ($\Uparrow_{TF}$) is derivable within a relational approach to propositional attitudes:[14]

(7⇑) For any proposition p, individual x, world w and time t the following holds:
$[\![\text{try}']\!]\ (p)\ (x)\ (w,t) = 1$ iff $p(w',t') = 1$, for any worlds w' and times t' such that $(w,t)\ T_x\ (w',t')$.

In (7⇑), the *accessibility* relation T_x is supposed to hold between world-time pairs, or *indices*, (w,t) and (w',t') if, and only if, (w',t') complies with the goals x pursues in world w at time t. The idea is that these goals can be identified with a separation between those indices (w',t') at which x's attempts (in world w at time t) are successful from those (w'',t'') at which they fail

12 See Section 4.1 and the references given there.

13 In other words, $\exists_P$ is the quantifier $\lambda Q\ (\exists y)\ [P(y) \wedge Q(y)]$. For the present purposes, the relation $\sqsubseteq$ of *being less general* may be defined as: $\lambda Q\ \lambda P\ \Box\ (\forall x)\ [P(x) \rightarrow Q(x)]$.

14 The *locus classicus* of this approach is Hintikka (1969).

or never came about in first place. To say that x tries to bring it about that a given proposition p is true then boils down to a claim about the success indices (w',t') , viz. that p holds in all of them.

According to (7⇑), the relation try' is *upward monotonic* (or *positive*) in its right argument:[15] whenever a proposition p implies – i.e. is a subset of[16] – a proposition q, the proposition that a given subject x stands in that relation to p implies the proposition that x stands in the same relation to q. In particular, since the proposition that x finds some P implies that x finds some Q whenever $P \sqsubseteq Q$, (7⇑) guarantees the validity of ($\Uparrow_{\mathrm{TF}}$). In other words, given a standard lexical decomposition (3) and a standard modal account (7⇑) of the underlying propositional attitude, the resulting analysis (8) of *seek* makes (M↑) come out as valid on semantic grounds:

(8) *Quine + Hintikka Analysis of* seek
For any quantifier $\mathfrak{Q}$, individual x, world w and time t the following holds:
$[\![\mathrm{seek}']\!]\,(\mathfrak{Q})\,(x)\,(w,t) = 1$ iff the property of being found by x is in the extension of $\mathfrak{Q}$ at (w',t'), for any worlds w' and times t' such that $(w,t)\ T_x\ (w',t')$.

Of course, monotonicity may also come about in the absence of (3) or (7⇑). On the other hand, it is instructive to see how (upward) monotonicity may fail. The following tentative analysis is not compatible with ($\Uparrow_{\mathrm{S}}$):[17]

(9) *Success-Oriented Analysis of* seek
For any quantifier $\mathfrak{Q}$, individual x, world w and time t the following holds:
$[\![\mathrm{seek}']\!]\,(\mathfrak{Q})\,(x)\,(w,t) = 1$ iff $(w,t)\ T_x\ (w',t')$, for any worlds w' and times t' such that the property of being found by x is in the extension of $\mathfrak{Q}$ at (w',t').

The idea behind (9) is that a search for an unspecific object successfully terminates as soon as a specific object with the right characteristics has been found: once there is a (specific) green sweater that he finds, the Jones of the premiss in (1) is happy, i.e. he is at an index complying with his goals. (9) thus construes unspecific searches as being directed to *arbitrary* objects of the kind described unspecifically.

Let us note in passing that the success-oriented analysis (9) is compatible with the Quinean decomposition (3) as long as the attitude expressed by *try* is not treated à la Hintikka (7⇑). If one takes the following, backward Hintikka approach (10) instead, (9) will follow:[18]

(7⇓) For any proposition p, individual x, world w and time t the following holds:
$[\![\mathrm{try}']\!]\,(p)\,(x)\,(w,t) = 1$ iff $(w,t)\ T_x\ (w',t')$, for any worlds w' and times t' such that $p(w',t') = 1$.

The accessibility relation in (9) and (7⇓) is the same as before. (9) thus reverses the implicational direction of the truth condition (8) and hence implies the obvious formalization ($\Downarrow_{\mathrm{S}}$) of (M↓):

($\Downarrow_{\mathrm{S}}$) $\Box\,(\forall x)\,(\forall P)\,(\forall Q)[Q \sqsubseteq P \rightarrow [\mathrm{seek}'(x,\exists_P) \rightarrow \mathrm{seek}'(x,\exists_Q)]]$

It follows that (9) is incompatible with a semantic account of the inference pattern (M↑). Otherwise one would get the unbearable consequence that the premiss of (1) leaves the objective of Jones's search completely open – which is what ($\Downarrow_{\mathrm{S}}$) and ($\Uparrow_{\mathrm{S}}$) together imply, as the

15 See, e.g., Moschovakis (1974: ch. 1), Ladusaw (1979), and van Benthem (1995, ch. 11) for the general notion of monotonicity and its relevance to logic and semantic analysis.

16 As usual, I identify sets with their characteristic functions relative to an obvious domain – the set of indices, in the case at hand. Also, by *the proposition that* … I mean the set of indices at which … holds.

17 Forbes (2003: 59) calls this kind of analysis 'happy outcome paraphrases'.

18 Of course, one must also assume that 'find'' in (3) does express the relation of finding.

reader may care to verify. However even if, on the basis of (9), some pragmatic explanation to the effect that (M↑) is correct could be concocted, one would still have to explain why (M↓) is not. And this looks hopeless if (M↓) were valid on semantic grounds.

Part of the intuition behind (9) may be saved, though, without totally giving up on (M↑). According to (9), for a search to be successful it is sufficient to find an object matching the description. But then it also appears to be necessary: it is hardly imaginable that a search is successfully terminated without a corresponding find. The following analysis thus suggests itself:[19]

(10) *Exact Match Analysis of* seek
For any quantifier $\mathfrak{Q}$, individual x, world w and time t the following holds:
$[\![\text{seek}']\!]\,(\mathfrak{Q})\,(x)\,(w,t) = 1$ iff, for any worlds w' and times t', $(w,t)\ T_x\ (w',t')$ holds iff at (w',t'),the property of being found by x is in the extension of $\mathfrak{Q}$.

(10) does not imply (M↓) – as little as it implies (M↑). But then maybe the latter could be derived by pragmatic reasoning. Conceivable strategies to this effect will be discussed in the later, as will be the very adequacy of (10) itself. For now let us note that (10) may also be obtained by the lexical decomposition (3), provided that one assumes an underlying back and forth Hintikka attitude:

(7⇔) For any proposition p, individual x, world w and time t the following holds:
$[\![\text{try}']\!]\,(p)\,(x)\,(w,t) = 1$ iff for any worlds w' and times t': $(w,t)\ T_x\ (w',t')$ iff $p(w',t') = 1$.

It thus turns out that, given the Montagovian approach to opacity, the monotonicity behaviour of an opaque verb is contingent on its lexical analysis. Given a Quinean paraphrase, the monotonicity of an opaque verb may be seen to reflect the monotonicity of its underlying attitude. Since the upward monotonicity inferences (M↑) appear to be warranted whilst downward monotonicity is definitely out, one may conclude that the Quine + Hintikka approach (8) is to be preferred over the other two, because it predicts upward (and bans downward) monotonicity without further pragmatic ado. The exact match analysis (10) is second best in that it is at least compatible with upward (and the rejection of downward) monotonicity, leaving the rest to pragmatic fine-tuning. Ironically, the loser is the success-oriented analysis (9) that reverses the desired monotonicity predictions and leaves little room for pragmatic repair. However, the following section will show that not all is well with upward monotonicity either.

The three lexical analyses discussed above are by no means the only conceivable ones within the Montagovian approach to unspecific objects as quantifiers, not even when one adds the Quinean reduction to propositional attitudes. As a case in point, the following, highly flexible decomposition strategy offers an alternative:

(11) *Varying Attitudes Analysis of* seek
For any quantifier $\mathfrak{Q}$, individual x, world w and time t the following holds:
$[\![\text{seek}']\!]\,(\mathfrak{Q})\,(x)\,(w,t) = 1$ iff, for any worlds w' and times t' such that (w,t) stands to (w',t') in x's (modal) attitude to $\mathfrak{Q}$ at (w,t), the property of standing in the relation x intends to stand in to $\mathfrak{Q}$ at (w,t) is in the extension of $\mathfrak{Q}$ at (w',t').

The idea underlying (11) is that the propositional attitude and the embedded relation underlying the unspecific reading of *seek* may change with the circumstances described: John may seek an old unicorn by trying to put himself in a position to see one, whereas Mary may be looking for a tall Norwegian in that she wants to marry one. (11) is certainly in need of further specification. In particular, it is left open which facts determine what a given subject's modal attitude in a given situation is, and what relation he or she intends to stand in to a given unspecific object. Let us nevertheless grant that there are ways of making these or related notions precise if only to see the rough outline of the resulting analysis. According to (11), it may still hold that the pertinent attitude is upward monotonic. Even so, since the attitude and

[19] Cf. Cooper (to appear) for a recent proposal along these lines.

the intended relation depend on the unspecific object of pursuit (as represented by the quantifier $\mathfrak{A}$) monotonicity does not necessarily carry over to the whole construction; for, according to (13), '$\mathfrak{A}$' does not only occur in the monotonic context created by the pertinent modal attitude, but also in the underlined environments where it helps determining that attitude and the relation in its scope. And whether the latter positions are monotonic depends on further analysis. For instance, wanting-to-marry may be Mary's attitude-cum-relation towards the object denoted by *a tall Norwegian* but not towards the denotation of *a Norwegian* – in which case ($\Uparrow_S$) would fail.

As the brief discussion shows, the varying attitudes are in need of further specification, but I can see no reason why (11) could not be turned into a viable lexical analysis of *seek*. I will still refrain from discussing it in the sequel, mainly because I would like to focus on the interaction between lexical monotonicity and logical form and the overall lexical monotonicity properties of (11) – neither ($\Uparrow_S$) nor ($\Downarrow_S$) are predicted[20] – are close enough to the exact match analysis (10), which is easier to compare to its contestants (8) and (9).

2. *The Monotonicity Problem*

2.1 *Quantifying over Unspecific Objects*

Consider the following inference:

(12) Jones is looking for a green sweater.
∴ Jones is looking for something.

At first blush, (12) looks like a variant of (1). Indeed, the inference may be construed as falling under the upward monotonicity pattern (M↑). In particular, still on the understanding that neither the premiss nor the conclusion are read specifically, (12) seems to be as valid an inference as (1). Treating *something* as an unrestricted existential quantifier as in (13), (12) may be formalized as (14a) or, given the decomposition (3), (14b):

(13) $\text{something}' = \lambda P\ (\exists x)\ P(x)$

(14a) $\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])$
∴ $\text{seek}'(\text{Jones}',[\lambda P\ (\exists y)\ P(y)])$

(14b) $\text{try}'(\text{Jones}',(\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{find}'(\text{Jones}',y)])$
∴ $\text{try}'(\text{Jones}',(\exists y)\ \text{find}'(\text{Jones},y))$

As we saw in the preceding section, the validity of the inference (14) depends on the exact lexical analysis of *seek*. On the other hand, given (13), the validity of (12) is a matter of logical form alone once premiss and conclusion receive their *specific readings*:

(15a) $(\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{seek}'(\text{Jones}',\lambda P\ P(y))]$
∴ $(\exists y)\ \text{seek}'(\text{Jones}', [\lambda P\ (\exists P)\ P(y)])$

(15b) $(\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{try}'(\text{Jones}',\text{find}'(\text{Jones}',y))]$
∴ $(\exists y)\ \text{try}'(\text{Jones}',\text{find}'(\text{Jones},y))$

[20] – at least not on a natural understanding of the analysis. I do realize that some perverse interpretation of *pertinence* renders (11) equivalent to (8) or even (10). If, for instance, in every possible world and at every time, trying were everybody's pertinent attitude and finding their intended relation, then (11) would boil down to the Quine + Hintikka analysis (8). Moreover, a bit of propositional logic calculation reveals that the variable analysis (11) collapses into an exact match on the following (admittedly artificial) assumptions: (a) any x's modal atttiude to any existential quantifier $\exists_P$ at any given index (w,t) holds between (w,t) and any (w',t') iff either: $(w,t)\ T_x\ (w',t')$ and the property of being found is *not* in the extension of $\exists_P$ at (w',t'); or else it is, but (w',t') is not T_x-accessible from (w,t); (b) no subject ever intends to stand to anything in any relation. Given (a) and (b), the condition in (13) boils down to the denial of (a), which is equivalent to the biconditional in (10).

However, as I will argue in a moment, there is indirect evidence that (12) should come out as an instance of Existential Weakening even if its premiss is not construed specifically. Obviously, in that case the conclusion is neither read as in (14) nor as in (15), but must rather be understood as *quantifying over unspecific objects*, as in (16), where $\mathfrak{Q}$ is a variable of type $(et)t$:[21]

(16a) $\underline{\text{seek'(Jones', } [\lambda P\ (\exists y)[\text{sweater'}(y) \wedge \text{green'}(y) \wedge P(y)]])}$
$\therefore$ $(\exists \mathfrak{Q})\ \text{seek'(Jones',}\mathfrak{Q})$

(16b) $\underline{\text{try'(Jones',}(\exists y)[\text{sweater'}(y) \wedge \text{green'}(y) \wedge \text{find'(Jones',}y)])}$
$\therefore$ $(\exists \mathfrak{Q})\ \text{try'(Jones',}(\mathfrak{Q}y)\ \text{find'(Jones',}y))$

According to the conclusion of (16), Jones's search is directed towards an unspecific object; in that respect this reading is like the unspecific reading given in (14). However, there is a subtle difference. Whereas the conclusion of (16) merely states that there is at least some unspecific object that Jones is after, the conclusion of (14) specifies one such object, viz. the denotation of something'. In terms of the above distinction, the conclusion in (16) is both unspecific and non-specificational. The one in (14), on the other hand, names an unspecific object testifying it and is, in that sense, specificational. In order to have a catchy term for this subtle distinction, I will will continue to call the latter construal the (*ordinary*) *unspecific* reading and refer to the former reading as *underspecific*. Let me just add that the distinction between unspecificity and underspecificity is aimed at the quantificational structure of the sentence, not at the proposition it expresses. In fact, under the classical analysis (8), the conclusions of (14) and (16) express the very same proposition: if Jones is looking for something, then – by monotonicity – he must be looking for the most general unspecific object. Still, the sentences do differ in the way in which the proposition is expressed. In the examples to be discussed next this difference will also have an effect on the propositions expressed.

(16) can be derived as a reading of (12), using the following translation of *something*:

(17) something' = $\lambda\Pi\ (\exists \mathfrak{Q})\ \Pi(\mathfrak{Q})$

Logical translation being a function, there is an obvious conflict between (13) and (17). In order to resolve it, I will, for the time being, assume that *something* is ambiguous. Given the close similarity between the two readings – after all, they only differ in logical type, not in substance – it is tempting to try and capture the difference between (13) and (17) with one indeterminate denotation. This would obviously go beyond the scope of the present framework,[22] but then the ambiguity may be felt to be a type-theoretic artefact. I think it is not, but I will not go into the matter here.

In order to see that *something* can indeed be used to quantify over unspecific objects, one may consider examples involving relative clauses:

(18) Jones is looking for something Smith is looking for.

Semantic folklore has it that the relative clause expresses a property obtained by abstracting from the missing object (represented by a *trace* variable) and to be combined with the noun by intersection:[23]

(19) λy try'(Smith',find'(Smith',y))

---

21 Zalta (1988: 216ff.) discusses inferences like (12) as instances of Existential Weakening; Geach (1965), though never addressing the pattern as such, makes ample use of them. Explicit arguments for, and analyses of, a relevant reading of *something* along the lines of (16) have been given in Moltmann (1997: 20) and Zimmermann (1993: 171f.). The following presentation is based on Section 2 of Zimmermann (to appear).

22 A type-theoretic framework that allows for such indeterminate denotations as the union of the two analyses of *something* can be found in the appendix to Zimmermann (to appear). Let me hasten to add, however, that the treatment of *something* offered in that paper is nevertheless of the ambiguity kind.

23 This interpretation of relative clauses was already proposed by Quine (1960: 110ff.) and later adopted by Montague (1970).

Due to compositionality reasons, the relative clause must be attached to the abstract noun -*thing* rather than the entire quantifier *something*.[24] As this head noun is void of content, intersection with it has no effect and (19) also serves as the argument to the binary quantifier denoted by *some*. The resulting (standard) interpretation of the object in (18) is:

(20a) $\lambda Q\ (\exists y)\ [\text{seek}'(\text{Smith}',[\lambda P\ P(y)]) \wedge Q(y)]$
(20b) $\lambda Q\ (\exists y)\ [\text{try}'(\text{Smith}',\text{find}'(\text{Smith}',y)) \wedge Q(y)]$

We thus obtain two readings of (18), depending on whether the object takes scope over the opaque verb (21) or not (22):

(21a) $(\exists y)\ [\text{seek}'(\text{Smith}',[\lambda P\ P(y)]) \wedge \text{seek}'(\text{Jones}',[\lambda P\ P(y)])]$
(21b) $(\exists y)\ [\text{try}'(\text{Smith}',\text{find}'(\text{Smith}',y)) \wedge \text{try}'(\text{Jones}',\text{find}'(\text{Jones}',y))]$
(22a) $\text{seek}'(\text{Jones}',[\lambda Q\ (\exists y)\ [\text{seek}'(\text{Smith}',[\lambda P\ P(y)]) \wedge Q(y)]])$
(22b) $\text{try}'(\text{Jones}',(\exists y)[\text{try}'(\text{Smith}',\text{find}'(\text{Smith}',y)) \wedge \text{find}'(\text{Jones}',y)])$

In the first, wide-scope reading, sentence (18) expresses that Smith and Jones are looking for the same (specific) object; in the second, somewhat unlikely reading, it says that Jones is after anything specifically sought by Smith. However, neither of the two above readings of (18) covers a situation in which both Smith and Jones are looking for a green sweater without either of them being looking for any particular sweater. That (18) is true of such a situation is more readily seen by considering the following variant:[25]

(18') Jones is looking for something Smith is looking for too.

It is obvious how to formalize this – underspecific – reading assuming higher-order quantification, and I do not see how to derive it without that assumption:[26]

(23a) $(\exists \mathfrak{Q})\ [\text{seek}'(\text{Smith}',\mathfrak{Q}) \wedge \text{seek}'(\text{Jones}',\mathfrak{Q})]$
(23b) $(\exists \mathfrak{Q})\ [\text{try}'(\text{Smith}',(\mathfrak{Q}y)\ \text{find}'(\text{Smith}',y)) \wedge \text{try}'(\text{Jones}',(\mathfrak{Q}y)\ \text{find}'(\text{Jones}',y))]$

Adapting the standard semantics of relative clauses, we may divide the higher-order variant of *something* into determiner and noun, both of which will have to be type-adapted accordingly. The following table specifies all types and denotations needed:

		***L**ower Order*	***H**igher Order*
something	*type*	$(et)\ t$ [=: q]	$(qt)\ t$
	denotation	$\lambda Q\ (\exists x)\ Q(x)$	$\lambda \Pi\ (\exists \mathfrak{Q})\ \Pi(\mathfrak{Q})$
some	*type*	$(et)\ ((et)\ t)$	$(qt)\ ((qt)\ t)$
	denotation	$\lambda P\ \lambda Q\ (\exists x)[P(x) \wedge Q(x)]$	$\lambda \Sigma\ \lambda \Pi\ (\exists \mathfrak{Q})[\Sigma(\mathfrak{Q}) \wedge \Pi(\mathfrak{Q})]$
-thing	*type*	et	qt
	denotation	$\lambda y\ (y = y)$	$\lambda \mathfrak{Q}\ (\mathfrak{Q} = \mathfrak{Q})$

Table 1: Types and denotations of some-thing

24 This complication is well known. See Heim & Kratzer (1998: 82f.) for discussion and references.

25 According to some speakers, only this variant has the reading in question. I do not know why the addition of *too* should be obligatory here, but I am relatvely sure that it is an independent phenomenon pertaining to the semantics and pragmatics of *too*. In any case I will ignore the whole phenomenon altogether and confine myself to the simpler variant (18).

26 As Martin Emms (p.c., 2004) pointed out to me, there is a connection between this higher-order construal of (18) and Geach's (1967) Hob-Nob sentence. However, there is a difference in that the intentional identity in *Hob believes that a witch blighted his mare, and Nob thinks <u>she</u> killed his sow* involves a(n underlined) personal pronoun where (18) has (a relative pronoun and) a trace. I suspect that the difference is relevant when it comes to accounting for Montague's (1970: 396) rule that 'multiple reference often necessitates transparency'. For it seems to me that the intentional construal only comes about when alternative interpretations of coreference (descriptive, *de re*) are contextually ruled out, e.g. by background assumptions concerning the existence of witches; cf. van Rooy & Zimmermann (1996: 134f.) on this point. On the other hand, the pertinent reading of (18) is quite straightforward, and even more so than any of its contestants, including the *de re* reading (21).

It may be noted in passing that, as it stands, the ***H*** reading of *some-thing* is not entirely adequate. Rather, higher-order existential quantification should somehow be restricted because otherwise the quantifier could be instantiated by (lower-order) *nothing*, thus allowing for unwelcome inferences like:

(24) I owe you nothing.
∴ I owe you something.

Presumably, the restriction would have to be on (ordinary) existential quantifiers;[27] I will ignore this complication for now and return to it in Section 3.2.

In order to obtain (23) using the analysis given in Table 1, one only needs to generalize the above relative clause treatment to higher-order traces. Applying the same re-bracketing as before, the relative clause in (18) receives the following interpretation:

(25a) $\lambda \mathbb{Q}$ seek'(Smith',$\mathbb{Q}$)
(25b) $\lambda \mathbb{Q}$ try'(Smith',($\mathbb{Q}y$) find'(Smith',y))

(25) can be obtained by directly combining the trace variable $\mathbb{Q}$ of type q with the opaque verb. Again, the head noun *-thing* is semantically trivial, so that the object of (18) receives the following higher-order interpretation:

(26a) $\lambda\Pi\ (\exists\mathbb{Q})$ [seek'(Smith',$\mathbb{Q}$) $\wedge\ \Pi(\mathbb{Q})$]
(26b) $\lambda\Pi\ (\exists\mathbb{Q})$ [try'(Smith',($\mathbb{Q}y$) find'(Smith',y)) $\wedge\ \Pi(\mathbb{Q})$]

Of course, this unary (higher-order) quantifier is obtained by the ***H*** interpretation of the determiner *some*. Finally, quantifying (26) into the matrix *Jones is looking for* $\mathbb{Q}$ leads to the desired underspecific construal (23). To summarize, Table 1 allows for the following readings of (18):

Order → / ↓ *Scope*	***L**ow*	***H**igh*
***N**arrow*	seek'(Jones',[$\lambda Q\ (\exists y)$ [seek'(Smith',[$\lambda P\ P(y)$]) $\wedge\ Q(y)$]])	–
***W**ide*	$(\exists y)$ [seek'(Smith',[$\lambda P\ P(y)$]) $\wedge$ seek'(Jones',[$\lambda P\ P(y)$])]	$(\exists\mathbb{Q})$ [seek'(Smith',$\mathbb{Q}$) $\wedge$ seek'(Jones',$\mathbb{Q}$)]

Table 2a: Readings of (18), without decomposition

	***L**ow*	***H**igh*
***N**arrow*	try'(Jones',$(\exists y)$[try'(Smith', find'(Smith',y)) $\wedge$ find'(Jones',y)])	–
***W**ide*	$(\exists y)$[try'(Smith',find'(Smith',y)) $\wedge$ try'(Jones',find'(Jones',y))]	$(\exists\mathbb{Q})$[try'(Smith',($\mathbb{Q}y$) find'(Smith',y)) $\wedge$ try'(Jones',($\mathbb{Q}y$) find'(Jones',y))]

Table 2b: Readings of (18), using decomposition (3)

The vertical division in Table 2 marks the ambiguity of *some-thing* according to Table 1; the horizontal division reflects un-/specificity. It may be noted that one of the four combinations of the interpretive parameters, viz. ***NH***, is unavailable because it leads to a type clash: the verb, being of type $q(et)$, cannot cope with an argument of type $(qt)t$. Hence it appears that Table 2 lists precisely those readings of (18) that can be obtained by letting these two parameters vary as much as possible. However, closer inspection of the interpretation mechanisms reveals

[27] This is what would be expected under the property analysis of Zimmermann (1993), according to which opacity only arises in connection with existential quantifiers (or their property counterparts). Note that the narrow-scope reading the Montagovian account of opacity assigns to the premiss of (24) is at best marginal.

that there are more complex ways of combining them. In particular, one may, as it were, activate the ***W***ide scope parameter twice over by scoping the ***H***igher-order reading of *something* over the opaque verb, at the same time assigning the variable bound by the quantifier wide scope. The result would be:

(27a) $(\exists \mathfrak{Q})[\text{seek}'(\text{Smith}',\mathfrak{Q}) \wedge (\mathfrak{Q}y)\ \text{seek}'(\text{Jones}',[\lambda P\ P(y)])]$
(27b) $(\exists \mathfrak{Q})[\text{try}'(\text{Smith}',(\mathfrak{Q}y)\ \text{find}'(\text{Smith}',y)) \wedge (\mathfrak{Q}y)\ \text{try}'(\text{Jones}',\text{find}'(\text{Jones}',y))]$

(27) is true of a situation in which Jones happens to be looking for his favourite pencil, whereas Smith is just after some instrument or other to jot down a note. And more combinations along these lines are conceivable. I suspect that none of them constitutes a genuine reading of (18) and that the parameters underlying Table 2 are indeed correct.

2.2 Adding Monotonicity

It is now obvious that, even given an unspecific construal of its premiss, the inference (12) comes out as an instance of Existential Weakening. In other words, given the fact that the higher-order analysis of *some-thing* is needed in order to obtain the underspecific ***WH*** reading (23) of (18), the conclusion that it also arises in the conclusion of (12) seems unavoidable. And this is so whether or not the general monotonicity pattern (M↑) is valid. One reading of (12), it seems, just does not fall under this pattern but under the pattern (∃) of (higher-order) Existential Weakening.

(∃) *x* is looking for a *P*.
∴ *x* is looking for something.

(∃a) $\text{seek}'(x, [\lambda Q\ (\exists y)[P(y) \wedge Q(y)]])$
∴ $(\exists \mathfrak{Q})\ \text{seek}'(x,\mathfrak{Q})$

(∃b) $\text{try}'(x,(\exists y)[P(y) \wedge \text{find}'(x,y)])$
∴ $(\exists \mathfrak{Q})\ \text{try}'(x,(\mathfrak{Q}y)\ \text{find}'(x,y))$

Given (∃), it is hard to see how the monotonicity pattern (M↑) could be upheld. For consider the following inference:

(28) Jones is looking for a green sweater.
Smith is looking for a pink hat.
∴ Jones is looking for something Smith is looking for (too).

(28) is clearly invalid. Yet it would have to be valid if *seek* obeyed upward monotonicity. For then (M↑) will have the unspecifically interpreted premisses imply the conclusion if the latter is construed underspecifically:

(28a) $\text{seek}'(\text{Jones}',[\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])$
$\text{seek}'(\text{Smith}',[\lambda P\ (\exists y)[\text{hat}'(y) \wedge \text{pink}'(y) \wedge P(y)]])$
∴ $(\exists \mathfrak{Q})[\text{seek}'(\text{Smith}',\mathfrak{Q}) \wedge \text{seek}'(\text{Jones}', \mathfrak{Q})]$

(28b) $\text{try}'(\text{Jones}',(\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge \text{find}'(\text{Jones}',y)])$
$\text{try}'(\text{Smith}',(\exists y)[\text{hat}'(y) \wedge \text{pink}'(y) \wedge \text{find}'(\text{Smith}',y)]$
∴ $(\exists \mathfrak{Q})[\text{try}'(\text{Smith}',(\mathfrak{Q}y)\ \text{find}'(\text{Smith}',y)) \wedge \text{try}'(\text{Jones}', (\mathfrak{Q}y)\ \text{find}'(\text{Jones}',y))]$

The reason why (28) comes out valid given upward monotonicity (M↑) is that the objects in the premisses denote existential quantifiers that are less general than the unrestricted quantifier expressed by the ***L*** reading of *something*:[28]

(29i) $[\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]] \sqsubseteq [\lambda Q\ (\exists x)\ Q(x)]$
(29ii) $[\lambda P\ (\exists y)[\text{hat}'(y) \wedge \text{pink}'(y) \wedge P(y)]] \sqsubseteq [\lambda Q\ (\exists x)\ Q(x)]$

Hence (M↑) may be applied to each of the premisses, leading to the conclusions in (30), where the objects obtain their ordinary unspecific readings:

[28] It should be noted that they are also less general than any unspecific object that is more general than their Boolean disjunction. Hence merely blocking the intermediate inference to the most general unspecific objct (denoted by the ***L*** reading of *something*) doesn't help.

(30i-a) seek'(Jones',[λQ ($\exists x$) $Q(x)$])
(30i-b) try'(Jones',($\exists y$) find'(Jones',y))
(30ii-a) seek'(Smith',[λQ ($\exists x$) $Q(x)$])
(30ii-b) try'(Smith',($\exists y$) find'(Smith',y))

Thus, starting from the premisses in (28) and using (30) as intermediate steps, the unrestricted existential quantifier [λQ ($\exists x$) $Q(x)$] turns out to be a witness for the conclusion in (28). The pattern underlying (28) is an *inference to a common objective*:[29]

(CO) x is looking for a P.
y is looking for a Q.
∴ x is looking for something y is looking for.

The upshot is that either (M↑) is wrong or else (CO) is valid. The latter alternative is rather unattractive. The inference is intuitively inacceptable, and it is unclear why this should be so given its purported semantic validity. The dilemma is that monotonicity inferences and inferences to a common objective go together, and hence blocking or accepting one means blocking or accepting the other. This is the *Monotonicity Problem*.

3. Opacity by Type Coercion

3.1 More Underspecificity

In Section 1 we have seen that the Quine + Hintikka analysis (8) of *seek* leads to upward monotonicity inferences. Hence in the light of the discussion in the preceding section, it looks like it ought to be given up. The success-oriented analysis (9) was bad for the independent reason that it invites downward monotonicity inferences. The exact match analysis (10) is better off than the other two: being inconsistent with both (M↑) and (M↓), it steers clear of the Monotonicty Problem without making obviously false predictions. Let us therefore tentatively adopt the exact match analysis and see how far we can get with it.

While the exact match analysis of *seek* avoids the Monotonicity Problem, it does have a problem with monotonicity: once the original inference (1) is blocked, the question arises why instances of (M↑) appear so straightforward.[30] A conceivable explanation coming to mind resorts to relevance, vagueness, and the shiftiness of standards: perhaps an inference like (1) appears valid because the exact kind of unspecific object Jones is reported to be looking for in the premiss is of no concern for the speaker or hearer. In other words, the difference between (unspecific) sweaters and (unspecific) red sweaters may be *neutralized* to a degree that the more general predicate (*sweater*) is acceptable as a means of referring to the narrower concept.[31] However, if this were so, one would expect the inference to go both ways: once the difference between (unspecific) sweaters in general and sweaters of specific colours is irrelevant, the corresponding downward entailment from conclusion to premiss in (1) ought to be just as acceptable as the original direction of inference. But it isn't. So this reasoning does not help. Since I am not aware of any other pragmatic approach to explain the apparent validity of (1), I will try and capture it by semantic means.

The exact match analysis (10) forces seek' to be a non-monotonic operator (with respect to the argument corresponding to the direct object). Hence trying to account for (M↑) in semantic terms might appear a hopeless task unless one is prepared to give up the exact match analysis. But it isn't and I am not. For help comes from closer inspection of the inference (12), which was used to motivate higher-order quantification in the previous section and is repeated here solely for the readers' convenience:

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29 (CO) is reminiscent of the *scope fallacy* (a.k.a. the *illicit quantifier-shift*) that is sometimes held responsible for a faulty reasoning to a first cause, leading from *Everything has a cause* to *Something (viz., God) is the cause of everything* – and from *Both Jones and Smith are wearing a sweater* to *There is a sweater that both Jones and Smith are wearing.*

30 At least to most speakers. A few appear to have intuitive difficulties with (M↑), and some even reject it. I will offer some speculation about these speakers' intuitions in the next section.

31 The kind of neutralization I have in mind is Lasersohn's (1999) *pragmatic halos*.

(12) Jones is looking for a green sweater.
∴ Jones is looking for something.

As noticed above, (12) looks like a monotonicity inference. Yet, on the underspecific reading of the conclusion, it is not. Rather, as the formalization (31) brings out, it is an instance of Existential Weakening and therefore valid even according to an exact match analysis of *seek*:

(31) $\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])$ [= (16a)]
∴ $(\exists \mathfrak{Q})\ \text{seek}'(\text{Jones}', \mathfrak{Q})$

In other words, higher-order Existential Weakening may create an appearance of upward monotonicity. This observation is the key to a solution to the monotonicity problem. The idea is to model the original inference (1) after (31); hence (1) – which, I take it, my readers still have in mind – is supposed to come out as something like:

(32) $\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])$
∴ $(\exists \mathfrak{Q})[\text{sweater}'(\mathfrak{Q}) \wedge \text{seek}'(\text{Jones}', \mathfrak{Q})]$

Of course, (32) is not even well-formed, let alone valid: as a predicate of type *et*, sweater' does not take unspecific objects as arguments. In order to turn (32) into a well-formed and valid argument, the right argument of seek' in the premiss would have to be a witness for the conclusion, which in turn means that the predicate sweater' would have to be replaced by a higher-order version ↑sweater' that is applicable to quantifiers:

(33) $\text{seek}'(\text{Jones}', [\lambda P\ (\exists y)[\text{sweater}'(y) \wedge \text{green}'(y) \wedge P(y)]])$
∴ $(\exists \mathfrak{Q})[\uparrow\text{sweater}'(\mathfrak{Q}) \wedge \text{seek}'(\text{Jones}', \mathfrak{Q})]$

The precise nature of the predicate ↑sweater' is immaterial as long as it guarantees that the quantifier expressed by *a sweater* falls under it. For instance, it is readily seen that either of the following predicates does the job:

(34) $\lambda \mathfrak{Q}\ (\exists Q)\ (\mathfrak{Q} = [\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)]])$
(35) $\lambda \mathfrak{Q}\ \Box\ (\forall P)\ [\mathfrak{Q}(P) \rightarrow (\exists y)\ [\text{sweater}'(x) \wedge P(x)]]$

Though not fully equivalent, (34) and (35) do agree on existential quantifiers. Restricting them in that way, we do not have to decide between the two: both may be read as designating unspecific objects that are less general than an unspecific sweater. Let us, for definiteness, adopt the somewhat simpler (34) as a provisional formalization of ↑sweater' in (33); it will eventually give way to a different analysis. In any case, the predicate ↑sweater' can obviously be derived from the ordinary reading of the noun in a systematic way, by letting ↑ be the following operator of type (*et*)(*qt*):

(36) $\lambda N\ \lambda \mathfrak{Q}\ (\exists Q)\ (\mathfrak{Q} = [\lambda P\ (\exists y)\ [N(y) \wedge Q(y) \wedge P(y)]])$

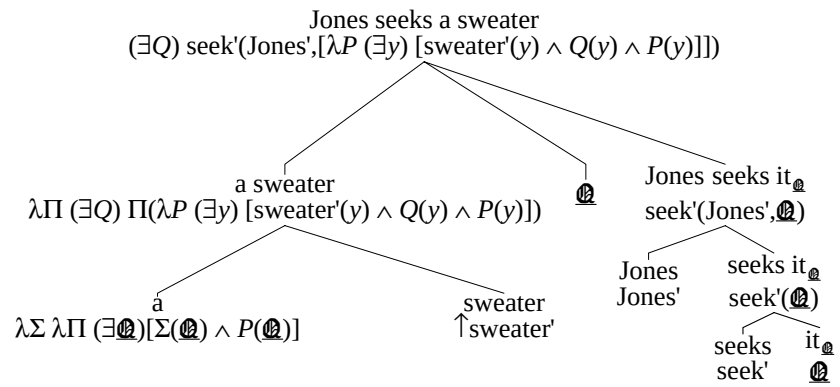
Whatever the source of the re-construal (34) of *sweater*, it is of the right type to combine with the higher-order version (37) of the indefinite article that we already encountered as the ***H*** reading of *some* in Table 1; the result is given in (38):

(37) $\text{a}' = \lambda \Sigma\ \lambda \Pi\ (\exists \mathfrak{Q})[\Sigma(\mathfrak{Q}) \wedge \Pi(\mathfrak{Q})]$

(38) $\text{a}'(\uparrow\text{sweater}')$
≡ $[\lambda \Sigma\ \lambda \Pi\ (\exists \mathfrak{Q})[\Sigma(\mathfrak{Q}) \wedge \Pi(\mathfrak{Q})]]\ (\lambda \mathfrak{Q}\ (\exists Q)\ (\mathfrak{Q} = [\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)]]))$
≡ $\lambda \Pi\ (\exists \mathfrak{Q})\ [(\exists Q)\ (\mathfrak{Q} = [\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)]]) \wedge \Pi(\mathfrak{Q})]$
≡ $\lambda \Pi\ (\exists Q)\ \Pi(\lambda P\ (\exists y)\ [\text{sweater}'(y) \wedge Q(y) \wedge P(y)])$

We thus arrive at the following account of one reading of the conclusion of (1):

(39)



Given this analysis, inference (1) can be obtained by Existential Weakening. If correct, (39) shows that – contrary to earlier suggestions[32] – underspecific readings are not peculiar to the 'grammatical' noun *-thing* but may also occur within noun phrases headed by ordinary lexical nouns. Further evidence for the existence of such readings will be given in Section 5.1.

The monotonicity effect caused by the wide scope construal (39) is independent of the lexical analysis of *seek* and would also arise on the basis of the Quine + Hintikka analysis (8) and the success-oriented analysis (9). We will have to bear this in mind until we return to the Monotonicity Problem cases in Section 3.3. For the time being, however, we will stick to the exact match analysis (10).

Let me sum up the proposal so far before I giving it its final formulation. Inferences like (1) and, more generally, those falling under the scheme (M↑), can be accounted for on the basis of a non-monotonic lexical construal (10) of the opaque verb *seek*, if the object takes wide scope and is given a higher-order reading derivable by re-interpreting its head noun as a predicate of unspecific objects. Given such a construal, the inferences become instances of Existential Weakening.

3.2 Coercion and Properties

Though we managed to reconcile the apparent upward monotonicity of *seek* with the exact match analysis, we only did so by assuming an additional, underspecific reading of the conclusion. The ordinary unspecific reading, according to which the object expresses an existential quantifier and takes narrow scope, is still with us. To be sure, that reading still blocks the monotonicity inference, due to the non-monotonicity of the exact match. Hence (1) ought to have a reading according to which the inference does not go through. In other words, the following sentence ought to have a consistent reading that does not involve specificity:

(40) Jones is looking for a green sweater, but Jones is not looking for a sweater.

Surely, this is odd.[33] However, an obvious way out of the embarrassment about (40) will emerge when we take a closer look at the derivation of (39).

The underspecific reading (39) requires a re-interpretation of the head noun *sweater* as referring to kinds of sweaters. This raises the question what the source of this re-interpretation is. The first guess may be the lexicon: perhaps *sweater* is just polysemous. The following variants of (1) show that matters cannot be as simple as that:

(41) <u>Jones is looking for a green sweater that he can afford.</u>
∴ Jones is looking for a green sweater.

(42) <u>Jones is looking for a green sweater that he can afford.</u>
∴ Jones is looking for a sweater that he can afford.

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32 That *-thing* is special in this respect is implicit in the accounts given in Zimmermann (1993: 171f.), Moltmann (1997: 20), and Section 2.3 of Zimmermann (to appear).

33 (40) may be rendered consistent on a speech-act construal of negation as denial, roughly paraphrasable as *I am not saying that Jones is looking for a sweater*. Note that this reading also occurs with transparent verbs, as in: *Jones does not drive a car – he drives a Porsche*. I am indebted to Helen de Hoop (p.c., 2004) for helpful discussion at this point. See also Forbes (2003: 57) for some critical discussion.

If (41) is to be explained along the same lines as (1), its conclusion must be assigned an underspecific reading, viz.:

(43) $(\exists \mathfrak{Q})\ [\uparrow\text{sweater}'(\mathfrak{Q}) \wedge \uparrow\text{green}'(\mathfrak{Q}) \wedge \text{seek}'(\text{Jones}',\mathfrak{Q})]$

The problem with (43) is that it not only requires a polysemous interpretation of *green* but also a generalization of adjectival modification to higher-order predicates: just as green' combines with sweater' to form a predicate of individuals, so must ↑green' be combinable with ↑sweater', resulting in a predicate of unspecific objects (i.e. quantifiers). Moreover, in order to capture (42) in the same way, the lifting operation would have to be performed on the predicate expressed by the relative clause:

(44) $(\exists \mathfrak{Q})\ [\uparrow\text{sweater}'(\mathfrak{Q}) \wedge \uparrow(\lambda y\ \text{can-afford}'(\text{Jones}',y))(\mathfrak{Q}) \wedge \text{seek}'(\text{Jones}',\mathfrak{Q})]$

Hence a general process is called for, applying to syntactically complex expressions and turning predicates of type *et* into higher-order predicates of type *qt*. Typically, such *coercion* processes are triggered by some kind of sortal mismatch. In the case at hand, it may not be obvious what this mismatch could consist in. After all, in its ordinary reading, the noun phrase *a sweater* denotes a quantifier, which – *qua* unspecific object – can serve as an argument to the opaque verb *seek*, giving rise to the unspecific reading. It thus looks like no ↑ shift and no ensuing quantifier raising are needed.

The attentive reader will have noticed that the above pessimistic reasoning depends on the assumption that unspecific objects are (existential) quantifiers. On any other approach to unspecificity, there would have to be a conflict between the ordinary denotation of the indefinite object – an existential quantifier – and the opaque verb's demand for an unspecific object. Hence a coercion approach to the higher-order re-interpretation of indefinite objects could possibly be put to work on the basis of an alternative approach to unspecific objects. Given the one-one correspondence between existential quantifiers $\exists_P$ and their restrictions P, *properties* are the prime alternatives to quantifiers when it comes to playing the rôle of unspecific objects.[34] In fact, the exact match analysis is readily reformulated in terms of properties:

(45) *Exact Match Analysis of* seek *(type adaptation)*
For any property P, individual x, world w, and time t the following holds:
$[\![\text{seek}']\!]\ (P)\ (x)\ (w,t) = 1$ iff, for any worlds w' and times t', $(w,t)\ T_x\ (w',t')$ holds iff at (w',t'), the set of individuals found by x overlaps the extension of P.

(45) preserves the substance of the earlier formulation (10) in that the relation defined here holds between a subject x and a property P at a given index (w,t) iff the relation defined in (10) holds between x and the existential quantifier $\exists_P$. However, types have changed, which is why the opaqe verb cannot be combined with the quantifier expressed by the object by functional application. The following shift may be used to repair the type mismatch:

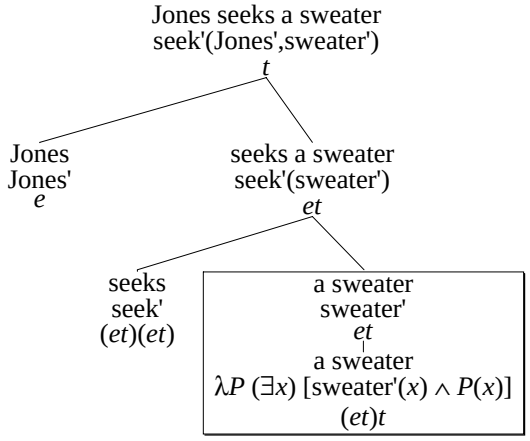
(46) *Existential Lowering*
From $\mathfrak{Q}$ of type $(et)t$ to $(\lambda x\ (\mathfrak{Q}y)\ x = y)$ of type et

When applied to an existential quantifier $\exists_P$, the operation in (46) yields its restrictor P.[35] Existential Lowering may be used to bring the lexical analysis (45) in line with the generalized quantifier interpretation of the indefinite object:

[34] The correspondence between quantifiers and properties is central to the theory of type shifting in Partee (1987). A treatment of properties as unspecific objects has already been given in Zimmermann (1993); the present approach will be compared to it in Section 5.4.

[35] Cf. Partee (1987: 126), where the operation is called *BE*, because it is based on Montague's (1970: 393) type-logical implementation of Quine's (1960: 152) analysis of the copula *be*.

(47)



In the highlighted part of this tree, the operation defined in (46) is applied to the quantifier expressed by the object to obtain a suitable argument for the opaque verb. This kind of type coercion appears necessary in order to derive the ordinary unspecific reading, which is what the analysis (47) boils down to. Arguably, the type conflict between verb and object is what triggers the application of this shift. However, Existential Lowering is not of any help when it comes to underspecific readings. Instead, we may adopt the strategy of the preceding subsection and lift the property expressed by the head noun to apply to unspecific objects. Following the version (45) of the exact match analysis, unspecific objects are properties, and thus the type lift needed here is considerably less complex than the ones envisaged in (34) and (35) above. In fact, the following operation mapping properties of individuals to the their sub-properties is all we need:

(48) *Property Lifting*
From N of type et to $[\lambda P\ P \sqsubseteq N]$ of type $(et)t$

– or, equivalently, to: $\lambda P\ (\exists Q)\ P = [\lambda x\ N(x) \wedge Q(x)]$

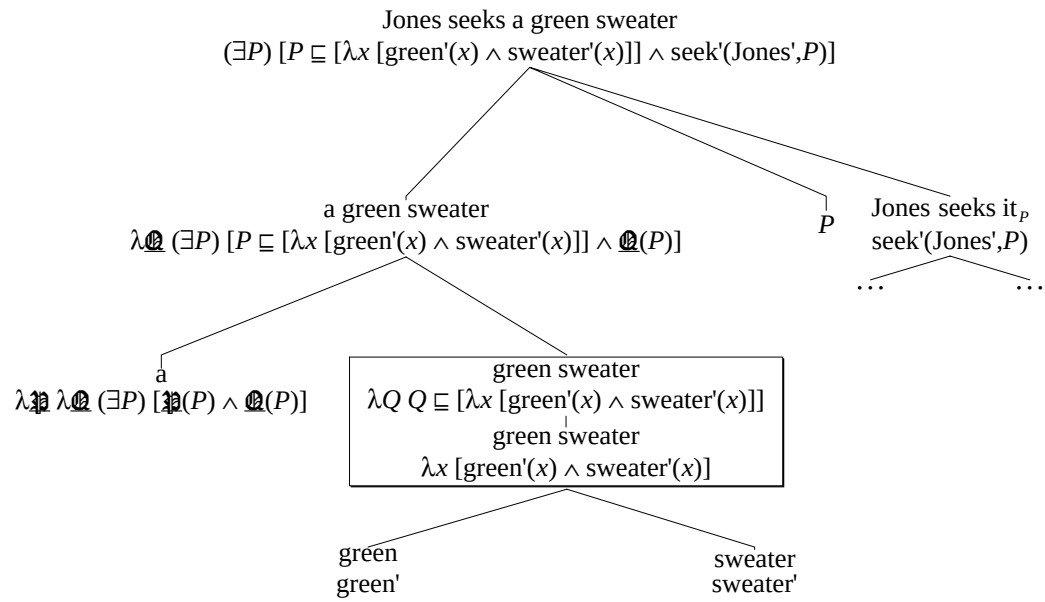
In order for (48) to be applicable to opaque verbs, we must still type-adapt the indefinite article to properties of unspecific objects, which is straightforward:

(49) $a' = \lambda\mathfrak{P}\ \lambda\mathfrak{Q}\ (\exists P)\ [\mathfrak{P}(P) \wedge \mathfrak{Q}(P)]$

We are finally in a position to give an account of the monotonicity inference (1) within an exact match analysis of *seek*. The relevant reading of the premiss is:[36]

[36] Though this is just what Condoravdi *et al.* (2001a; 2001b) had propesed – albeit with a different motivation (to which I will come in Section 5.2) –, I only became aware of this analysis in the discussion following my presentation of the monotonicity problem at the University of Texas (cf. the final note); the essential proposal – to use a higher-order re-interpretation – was made by Josh Dever, to whom I am deeply indebted. A year earlier, Tim Fernando (p.c., 2001) already suggested to me to replace unspecific readings by wide-scope higher-order quantification and an exact match analysis; at the time he did not convince me, because I was unaware of the monotonicity problem and thought of the higher-order formalization as a baroque way of forcing quantifier raising – *pace* May (1985).

(50)



The box again marks the place where a type shift occurs – this time the one defined in (48). Note that the adjective (which, for simplicity, I take to be intersective) modifies the noun before Property Lifting is applied so that, indeed, there is no need for a special higher-order modification construction. The conclusion of (1) can be derived in a parallel fashion, resulting in (51), which is a logical consequence of [the top formula in] (50):

(51) $(\exists P)\ [P \sqsubseteq \text{sweater}'(x) \wedge \text{seek}'(\text{Jones}',P)]$

(51) follows from (50) by the (assumed) Boolean structure of the space of properties: being a green sweater (= the meet of being green and being a sweater) is less general than being a sweater and thus any P that is less general than the former, is less general than the latter, by the transitivity of being less general; hence if P testifies the premiss, it is also a witness for the conclusion. In fact, using the alternative but equivalent formulation of the type shift (48), the inference from (50) to (51) turns out to be an instance of second-order Existential Weakening. It is obvious that the original inference (1), if construed in this way, is independent of the lexical analysis of *seek* and should therefore occur with all opaque verbs. I think this prediction is correct; an alleged counter-example will be discussed in Section 5.2.

Let us compare the underspecific readings of the exact match analysis to the *in situ* construals according to the Quine + Hintikka analysis (8). This is how the unspecific reading of the conclusion of (1) comes out according to the latter:[37]

(52) $[\![\text{seek}']\!]([\![\text{a}'(\text{sweater}')]\!])([\![\text{Jones}']\!])(w,t) = 1$

iff the property of being found by $[\![\text{Jones}']\!]$ is in the extension of $[\![\text{a}'(\text{sweater}')]\!]$ at (w',t'), for any worlds w' and times t' such that $(w,t)\ T_{[\![\text{Jones}']\!]}\ (w',t')$

iff for any worlds w' and times t' such that $(w,t)\ T_{\text{Jones}}\ (w',t')$, there is an object y such that y is a sweater in w' at t' and Jones finds y in w' at t'

Following the revised version (45) of the exact match analysis, the truth conditions of the underspecific reading of the same sentence come out as follows:[38]

---

[37] The final condition in (52) may be made more transparent by recasting it in logical symbolism:
$[(\forall w')\ (\forall t')\ [\text{GOAL}_{w,t}(\text{j},w',t') \rightarrow (\exists y)\ [\text{SWEATER}_{w',t'}(y) \wedge \text{FIND}_{w',t'}(\text{j},y)\ ]]]$

[38] Again the symbolic version is slightly more transparent:
$(\exists P)\ [\ (\forall w')\ (\forall t')\ (\forall x)\ [[P_{w',t'}(x) \rightarrow \text{SWEATER}_{w',t'}(x)] \wedge$
$(\forall w')\ (\forall t')\ [\text{GOAL}_{w,t}(\text{j},w',t') \leftrightarrow (\exists y)\ [\text{FIND}_{w',t'}(\text{j},y) \wedge P_{w',t'}(y)]]]]]$

(53) $[\![(\exists P)\ [P \preceq \text{sweater} \wedge \text{seek}'(\text{Jones}',P)]]\!](w,t,) = 1$

iff for some property $P \sqsubseteq [\![\text{sweater}']\!]$, $[\![\text{seek}']\!](P)[\![\text{Jones}']\!](w,t) = 1$

iff for some property P such that x is a sweater in w' at t' whenever $P(x)(w',t') = 1$ (for any index (w',t') and individuals x), it holds that any worlds w' and times t' satisfy the following condition: $(w,t)\ T_{\text{Jones}}\ (w',t')$ iff the set of individuals found by Jones in w' at t' overlaps the extension of P at (w',t')

A little bit of reflection and/or calculation – which I leave to the reader – shows that (52) and (53) are logically equivalent.[39]

Not counting specificity, there are two combinations of readings that make the monotonicity inference (1) go through. The first is the one we have just seen, i.e. from an underspecific premiss to an underspecific conclusion. Moreover, if the premiss receives its ordinary unspecific reading (derivable by way of Existential Lowering), then the conclusion also follows, albeit only on its underspecific reading – the ordinary unspecific reading being blocked by the exact match analysis of *seek*. And the latter does *not* follow from the underspecific reading (50) of the premiss either. Since the matter is of prime importance for the rest of the paper, let us look at the alleged consistency of (40) in some detail. Here are the formal versions of the readings in question:

(40) Jones is looking for a green sweater, but Jones is not looking for a sweater.

(54) $[\text{seek}'(\text{Jones}',\lambda x\ [\text{green}'(x) \wedge \text{sweater}'(x)]) \wedge \neg\ \text{seek}'(\text{Jones}',\text{sweater}')]$

(55) $[(\exists P)[P \preceq [\lambda x\ [\text{green}'(x) \wedge \text{sweater}'(x)]] \wedge \text{seek}'(\text{Jones}',P)] \wedge \neg\ \text{seek}'(\varepsilon)\ (\text{Jones}',\text{sweater}')]$

(54) is the conjunction of the unspecific reading of the premiss of (1) with the negation of the unspecific reading (47) of the conclusion; (55) is the conjunction of the underspecific reading (50) of the premiss with the negated unspecific reading of the conclusion. Given the exact match analysis (45), both formulae are consistent. To see this, it suffices to consider an arbitrary index at which Jones is engaged in a search ε that is successful just in case he finds a green sweater, without being engaged in any other search. (54) is true at such an index: ε trivially verifies the first conjunct, and it does not verify (47), because it would not be successful at an index at which he finds a red sweater; and since Jones is not engaged in any other search than ε, the second conjunct is also true. Similarly, the first conjunct of (55) is verified by the property of being a read sweater itself; and hence (55) is true at that index too.

It is clear what the source of all the trouble is: if it were not for *the unspecific reading* (47), the inference (1) would go through; and (40) would be inconsistent if it were not for the negation of the unspecific reading.

In fact, the unspecific exact match reading is quite odd anyway. The premiss of (1) just does not seem to express that Jones would be satisfied just in case he found any sweater whatsoever. For instance, under normal circumstances a garment soaked in anthrax powder would be unlikely to satisfy his needs; and (56) would not be judged as true under such circumstances just because such an unhealthy piece of clothing would not satisfy Jones:[40]

(56) Jones is not looking for a sweater.

Of course, Jones might stop looking for a sweater because he finds a contageous one without realizing it. In that case his search would be over, but it would not be successful: a poisened sweater was not what he was looking for. In other words, under normal circumstances, there is no exact match between finding a sweater and a successful end to Jones's search. Rather, the match concerns sweaters *of the right kind*, i.e. a property that is less general than the one expressed by *sweater*. We thus find that the richness of Logical Space offers an independent

[39] That (53) implies (52) is obvious; in order to prove the reverse direction, one may instantiate (53) by $P = \lambda y\ \lambda t'\ \lambda w'\ [\text{GOAL}_{w,t}(\text{j},w',t') \wedge \text{SWEATER}_{w',t'}(y) \wedge \text{FIND}_{w',t'}(\text{j},y)]$.

[40] I owe this example to Graeme Forbes (2002, p.c). See Forbes (2003: 72) for a similar consideration.

motive for banning the unspecific reading: in general there are far too many possible situations in which the success condition is met if it is only defined in terms of the restriction of the indefinite object. Rather, a further condition ought to restrict the intended objects of search – being free of poison, of the right kind of material, cosy, or what have you. The underspecific reading sneaks such a restriction into the truth conditions by demanding an exact match between the subject's needs and some *sub-property* of the object's restrictor. By bringing in the restrictor itself into the success condition, the unspecific reading, however, is more demanding – and consequently less adequate.[41]

The upshot of this observation is that we better eliminate the unspecific reading altogether, leaving unspecific searches to be described in terms of underspecific readings – which, as we have just seen, is equivalent to the ordinary unspecific reading based on the Quine + Hintikka account of *seek*. The property approach to unspecificity has no problem with disposing of the unspecific reading. We just have to do away with Existential Lowering (49) as a coercion strategy, or at least as one that is applicable to indefinite objects of opaque verbs. This would not bear on the underspecific reading, which may still be derived by – quantifier raising and – Property Lifting (51). This, then, leads to our motivation for switching from quantifiers as unspecific objects to properties. Given the otherwise identical analysis of the previous subsection, the apparent non-existence of the unspecific reading is a complete mystery: expressing existential quantifiers, indefinites would be unspecific objects *par excellence*, combinable with the meanings of opaque verbs by the simplest semantic combination, functional application. On the contrary, and as we already noted at the end of the previous subsection, the very existence of underspecific readings is hard to explain if no type mismatch triggers the coercion process (51).

In my (possibly non-representative) experience, the elimination of unspecific exact match readings appears to square most speakers' intuitions about reports of unspecific searches. Yet some of us disagree with the judgments it is based on. Among them are those that perceive an ambiguity between underspecificity and unspecificity, as well as those that deny the existence of underspecific readings. I suspect that their dialects can be accomodated within the present approach by some re-setting of parameters. For instance, the ambiguity is easily accounted for by admitting Existential Lowering (49) as a relevant coercion strategy – just as we did until a paragraph ago; and underspecificity goes away by blocking Property Lifting (48) at the same time. Of course, it would have to be checked that these changes do not cause havoc when it comes to other examples and constructions; but I will leave these matters for further research and concentrate on those dialects in which sentences like (40) force a specific interpretation of (exactly) one of the conjuncts to preserve coherence.

3.3 Unspecific -things *Revisited*

Having eliminated the unspecific readings, we are left with the specific and the underspecific ones. Since the latter are equivalent to the unspecific readings the classical approach assigns to indefinite objects of opaque verbs, one may wonder what the switch from Qunie + Hintikka to the exact match analysis has bought us. Of course, the answer lies in the treatment of quantification over unspecific objects, which gave rise to the Monotonicity Problem. The critical example was:

(18) Jones is looking for something Smith is looking for.

The reading that led to the Monotonicity Problem was one according to which (18) reports Jones and Smith to be looking for the same unspecific object. Given our present reconstruction of unspecific objects, *something* must now quantify over properties rather than (existential) quantifiers – just like the underspecifically construed indefinites obtained by Quantifier Lifting. So in order to borrow the analysis given in Section 2.1, the higher-order interpretation of *something* must be adapted as in Table 3, where the abbreviation '*p*' has been introduced as an *ad hoc* notation to stress the analogy between the right columns of Tables 1 and 3:[42]

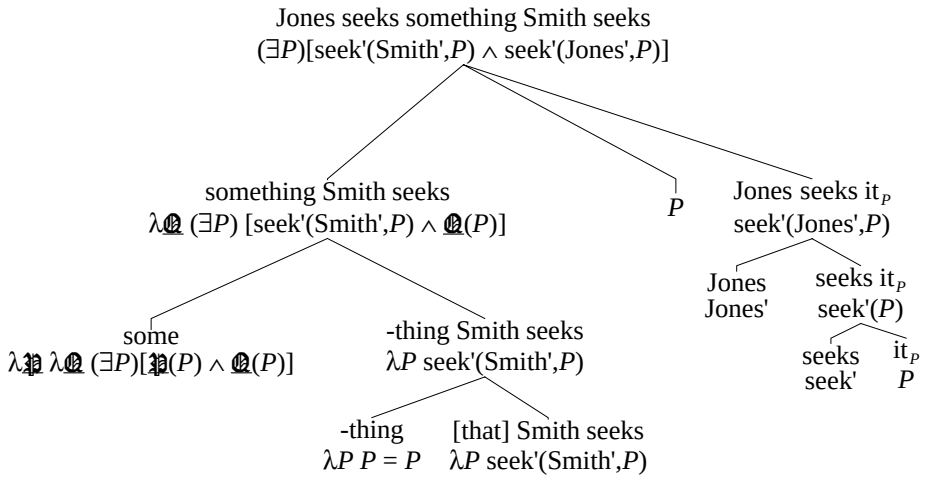
[41] There may be a way of getting around this problem by somehow directly restricting the unspecific reading. For instance, a built-in context-dependence of the object's restrictor may be a way to go. I leave this option open for further research.

		***L**ower Order*	***H**igher Order*
something	*type*	$(et)t$ [= pt]	$(pt)t$
	denotation	$\lambda Q\ (\exists x)\ Q(x)$	$\lambda \mathfrak{Q}\ (\exists P)\ \mathfrak{Q}(P)$
some	*type*	$(et)\ ((et)t)$	$(pt)((pt)t)$
	denotation	$\lambda P\ \lambda Q\ (\exists x)[P(x) \wedge Q(x)]$	$\lambda \mathfrak{P}\ \lambda \mathfrak{Q}\ (\exists P)\ [\mathfrak{P}(P) \wedge \mathfrak{Q}(P)]$
-thing	*type*	et	pt
	denotation	$\lambda y\ (y = y)$	$\lambda P\ (P = P)$

Table 3: Revised types and denotations of some-thing

We thus arrive at the following property-based formalization of (18):

(57)



The Monotonicity Problem is that, according to the classical approach to opacity, (18) is a semantic consequence of any pair of non-specific search reports about Smith and Jones. More generally, any monotonic lexical analysis of *seek* leads to the following schematic inference to a common objective (repeated from Section 2.2):

(CO) *x* is looking for a *P*.
y is looking for a *Q*.
∴ *x* is looking for something *y* is looking for.

Following the standard analysis, the inference goes through if the premisses are given an unspecific interpretation, whereas the conclusion receives a higher-order reading, with *something* quantifying over unspecific objects. The present approach avoids this problem. Although, as we saw in the previous subsection, the underspecific readings of the premisses essentially preserve the truth conditions of the old unspecific readings, they do not jointly imply the higher-order conclusion (57), as long as the latter is based on an exact match analysis. In logical notation, the relevant combination of readings of (CO) comes out as follows:

(CO*) $(\exists P')\ [P' \sqsubseteq P \wedge \text{seek}'(x,P')]$ [= (51)]
$(\exists Q')\ [Q' \sqsubseteq Q \wedge \text{seek}'(x,Q')]$
∴ $(\exists N)\ [\text{seek}'(\text{Jones}',N) \wedge \text{seek}'(\text{Smith}',N)]$

It is obvious by now that (CO*) is not a valid inference pattern if seek' is interpreted along the lines of the exact match analysis: standing in the seek'-relation to one unspecific object simply does not affect one's relation to other such objects, be they more general or not. And, to be sure, other combinations of readings do not make the alleged inference pattern any better. So the

[42] Note that the ***H*** reading of *-thing* is equivalent to $\lambda P\ P \sqsubseteq [\lambda y(y = y)]$ and is therefore derivable from the ***L*** reading by Property Lifting (48).

present analysis does solve the Monotonicity Problem. The exact match interpretation of seek' also blocks the special case of (CO) in which P and Q happen to denote the same property. Here is a case in point:

(58) Jones is looking for a sweater.
Smith is looking for a sweater.
∴ Jones is looking for something Smith is looking for.

Like the the general pattern (CO*), the relevant construal of (58) – underspecific premisses, higher-order conclusion – is invalid:

(58*) $(\exists P)\ [P \sqsubseteq \text{sweater}' \wedge \text{seek}'(\text{Jones}',P)]$ [= (51)]
$(\exists Q)\ [Q \sqsubseteq \text{sweater}' \wedge \text{seek}'(\text{Smith}',Q)]$
∴ $(\exists N)\ [\text{seek}'(\text{Jones}',N) \wedge \text{seek}'(\text{Smith}',N)]$

Appearences to the contrary, this is as it should be. For if Jones is looking for a red sweater and Smith is looking for a green sweater, the premisses in (58) are both true on their underspecific readings but the conclusion is not: Smith and Jones are looking for different things. Similar remarks apply to the following variations of (58) that may bring out the point more clearly:[43]

(59) Jones is looking for a sweater.
Smith is looking for a sweater.
∴ Jones is looking for the thing Smith is looking for.

(60) Jones is looking for a sweater.
Smith is looking for a sweater.
∴ Jones is looking for a sweater Smith is looking for.

As we will see in Section 4.2, higher-order readings of definite objects cause a technical complication, which is why we will defer the analysis of (59). However, the means of analyzing the relevant reading of (60) are available. As it turns out, though the conclusion does have an underspecific reading where a trace of type *et* is bound by the implicit relative pronoun, it is not implied by the underspecific readings of the premisses. Neither is the inference correct on any other combination of readings. Inspection of the details is left to the readers.

The above solution to the Monotonicity Problem crucially depends on the elimination of the ordinary unspecific reading; otherwise (CO) would have gone through. On the other hand, the exact match analysis was originally motivated by its non-monotonicity predictions for ordinary unspecific readings. Now we have given up the latter, the question arises which rôle, if any, the exact match analysis plays in the solution to the Monotonicity Problem. After all, the elimination of the unspecific reading was a result of the revision (45) of the exact match analysis (10), when quantifiers as unspecific objects gave way to properties. Clearly, analogous revisions can be formulated for the Quine + Hintikka analysis (8) and the success-oriented analysis (9).[44] However, as far as the former is concerned, this would not help in solving the Monotonicity Problem. For even after discarding the ordinary unspecific readings, the lexical upward monotonicity of the Quine + Hintikka analysis causes the property of being self-identical to be a common objective of all searches, thus validating (CO). Similarly, due to downward monotonicity, the success-oriented analysis (9) makes the property of being self-distinct a common objective of all searches, so that underspecific search reports come out as tautologous. Hence the non-monotonicity of the exact match analysis (10) is vital for the solution of the Monotonicity Problem in terms of underspecific readings.

Let me end this section by listing the main ingredients of the analysis of opacity proposed here:[45]

[43] The conclusion of (64') is reminiscent of the higher-order readings discussed in Moltmann (1997: 7), where objects of the form *the same thing* are considered.

[44] … or the varying attitudes analysis (11), which however I continue to ignore.

[45] The analysis presented here also makes use of quantifier raising, which is not itself a type-coercion mechanism but does help

Properties as unspecific objects
seek expresses a relation between a subject (the seeker) and a property (the unspecific object of search).

Exact match
The relation expressed by *seek* holds true if the seeker's goal is reached just in case (s)he finds a specific object with the unspecific object as a property.

Type coercion
The indefinite object is re-interpreted as (existentially) quantifying over unspecific objects that are more general than the property expressed by its restrictor.

3.4 Lexical Refinements

As it stands, the exact match analysis cannot be correct. Imagine that Jones is entering a clothes store in order to buy a green sweater for his son and a tie for himself. It would then seem that the premiss of (1) is true although the indices complying with Jones's goals in that situation are such that at them he finds both a sweater and a tie. However, according to (10), the premiss of (1) would be false under these circumstances: any index at which Jones finds a green sweater without finding a tie would have to comply with Jones's goals.[46] One may try to get out of this embarassment by varying the relevant notion of a goal. However, I think there is a more natural way to go about. Seeking and trying are not just attitudes but rather actions based on, and individuated in terms of, both attitudes and acitivities. For the case at hand this means that one should distinguish between the goal-directed activities Jones is carrying out in order to find a sweater and the goal-directed activities he is carrying out in order to find a tie. The difference may be intensional in that the two kinds of activities may happen to coincide, as it will typically be the case if neither goal is reached, but also if both are reached simultaneously. Even so the actitivities *would have* been different, *if* (say) the goals had not been reached simultanously. In order to account for this interaction of attitude and activity, let us invoke *events*[47] in the evaluation of *seek* by having the accessibility relation T specify the indices at which a particular search act is successfully terminated; under the assumption that the agent depends on the act ε, a further relativization of T to the subject x is not needed:

(61) *Exact Match Analysis of* seek *(Davidsonian refinement)*
For any property P, individual x, world w, and time t the following holds:
$[\![\text{seek}']\!]\,(P)\,(x)\,(w,t) = 1$ iff there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition: $(w,t)\ T_{\varepsilon}\ (w',t')$ iff the property of being found by x overlaps the extension of P at (w',t').

According to (61), the truth conditions of a search report only depend on the *existence* of a certain kind of act. For the present purposes this narrow-scope policy will be sufficient. A more thorough analysis would employ an event *parameter* as an argument to the verb meaning. Such a treatment would be needed to cope with adverbial modification, as in *Jones is desparately looking for a book*. Hence the other analyses of *seek* would be in need of an event parameter too:

(62a) *Quine + Hintikka Analysis of* seek *(Davidsonian refinement)*
For any property P, individual x, world w, and time t the following holds:
$[\![\text{seek}']\!]\,(P)\,(x)\,(w,t) = 1$ iff there is a search act ε performed by x in w at t such that the property of being found by x overlaps the extension of P at (w',t'), for any worlds w' and times t' such that $(w,t)\ T_{\varepsilon}\ (w',t')$.

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making the syntactic input interpretable; cf. Heim & Kratzer (1998: 219). I suspect that this is not an essential feature of the analysis, though.

46 The problem is not that, according to the exact match analysis, the object of *seek* is uniquely determined – it isn't. For instance, if the conclusion of (1) is true, then according to (10), Jones would have to stand in the relation $[\![\text{seek}']\!]$ to the quantifier expressed by *a sweater* as well as the (distinct) quantifier expressed by *a sweater found by Jones*.

47 To be sure, that truth-conditions of search reports ought to depend on events in the sense of Davidson (1967) and Parsons (1990) has been noted before – to wit in Forbes (2003).

(b) *Success-Oriented Analysis of* seek *(Davidsonian refinement)*
For any property P, individual x, world w, and time t the following holds:
$[\![\text{seek}']\!]\,(P)\,(x)\,(w,t) = 1$ iff there is a search act ε performed by x in w at t such that:
$(w,t)\ T_\varepsilon\ (w',t')$, for any worlds w' and times t' such that the property of being found by x overlaps the extension of P at (w',t').

The notion of a search act is to be understood as applying to (possibly very complex) actions performed by subjects and directed at finding objects. More precisely, we will the accessibility relation T assume to satisfy the following

(SP) *Seeking Postulate*
If ε is a search act performed by an individual x in a world w at a time t, then:
- there are worlds w' and times t' such that $(w,t)\ T_\varepsilon(w',t')$, and
- for any such (w',t') there is an individual y such that x finds y in w' at t'.

The exact match analysis appears to be in need of yet another amendment. Suppose that Jones is looking for a green sweater while being under the (false) impression that green sweaters are necessarily made of cotton – other materials allegedly being unsuitable for one reason or another. It would then seem that, by looking for a green sweater, Jones is also looking for a green cotton sweater: any index complying with Jones's goals would have to be one at which the extensions of *a green sweater* and *a green cotton sweater* coincide. However, since Jones is looking for a green sweater, according to (61), the set GS of indices at which he finds one would have to coincide with the set ST of indices at which his search is successfully terminated. By the same token, since Jones is looking for a green cotton sweater, the set GCS of indices at which he finds a green cotton sweater would also have to coincide with ST. But then GS would have to coincide with GCS, which it does not: unbeknownst to Jones, Logical Space contains indices at which he finds a green sweater without finding a green cotton sweater. Again there is an obvious way out. For although GS „ GCS, the two sets coincide if restricted to Jones's background, i.e. to the indices that are compatible with what Jones takes to be the case. More generally, then, the match between the goal and the indices at which the unspecific object applies to the specific objects found by the subject could be relativized to the latter's *doxastic perspective*. We would thus arrive at the following analysis:

(63) *Exact Match Analysis of* seek *(tentative revision)*
For any property P, individual x, world w, and time t the following holds:
$[\![\text{seek}']\!]\,(P)\,(x)\,(w,t) = 1$ iff there is a search act ε performed by x in w at t such that any worlds w' and times t' satisfy the following condition: if $(w,t)\ B_x\ (w',t')$, then $(w,t)\ T_\varepsilon\ (w',t')$ iff the property of being found by x overlaps the extension of P at (w',t').

In (63), B is a subject-dependent accessibility relation that holds between indices (w,t) and (w',t') if, for all the subject believes in w at t, (s)he could be in w' at t'.[48] From what was said in the previous paragraph, it is clear that the relations T and B are not independent of each other. More specifically, I take it that goals must be subjectively achievable, i.e. that any goal-compliant index must be in tune with what the subject takes to be possible:

(GP) *Goal Postulate*
If ε is a search act performed by an individual x in a world w at a time t, then:
- for any index (w',t') it holds that $(w,t)\ B_x(w',t')$, whenever $(w,t)\ T_\varepsilon(w',t')$.

Given this relation, it it is readily seen that the relativization to the subject's perspective would not be needed in version (61) of the Quine + Hintikka analysis: the quantification over goal-complying indices implies the restriction to doxastic accessibility. But neither is the exact match analysis in need of revision (63), the work being done by the logical account of opacity. True, given the Davidsonian version (61) of the exact match analysis, Jones cannot stand in the *seek*-relation to both the property GS of being a green sweater and the property GCS of

[48] Cf. Hintikka (1969).

being a green cotton sweater, at least not if he is engaged in a single search ε. Otherwise the success indices of ε could be characterized both as precisely those at which Jones finds a green sweater and as precisely those at which he finds a green cotton sweater; but, due to the richness of Logical Space, the latter two sets of indices are not identical. Consequently, given Jones's background, the unspecific readings of (64a) and (64b) cannot both be used to truthfully report on a single search:

(64a) Jones is looking for a green sweater.
(b) Jones is looking for a green cotton sweater.

However, the *unspecific* readings we eliminated. What's left are *underspecific* readings, according to which (64a) and (64b) may both be true given the circumstances. In fact, if all success indices of Jones's search act ε are such that he finds a green cotton sweater at them, then at all of them he finds something with the property P of being a sweater he finds at a success-index of ε. Consequently, given that P is a sub-property of both GS and GCS, (64a) and (64b) come out true in these circumstances. More generally, whenever a subject does not distinguish between two properties P and Q, then the (underspecific) report that [s]he is looking for some P will be true just in case [s]he is looking for a Q: according to the Goal Postulate (GP), any sub-property of P to which the subject stands in the relation denoted by *seek* will be a sub-property of Q, and vice versa.

4. *Specificity and Related Topics*

4.1 *Specific Readings of Indefinites*

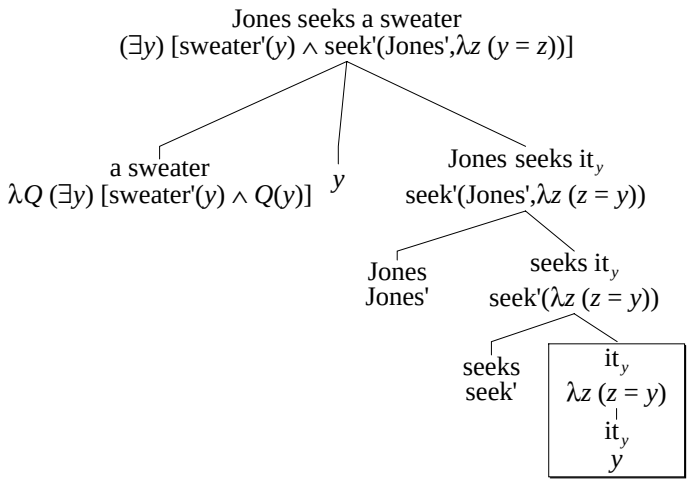
As to the specific readings of the sentences discussed, the present approach has nothing new to offer. Ever since Quine's pioneering work on opacity, it has been widely recognized that specificity can be dealt with in terms of quantifier scope, and I will follow this strategy here. Hence, as in the case of the underspecific reading, the indefinite object outscopes the opaque verb. However, instead of type-shifting the quantifier itself, a coercion mechanism locally applies to combine its trace with the verb. There are basically two possibilities of reconciling the trace of the unshifted quantifier with the argument type demanded by the opaque verb:[49]

(65) *Essential Lifting*
From y of type e to $[\lambda z\ (z = y)]$ of type et

(66) *Argument Lowering*
From $\Re$ of type $(et)(et)$ to $[\lambda y\ \lambda x\ \Re(x,\lambda z\ (z = y))]$ of type $e(et)$

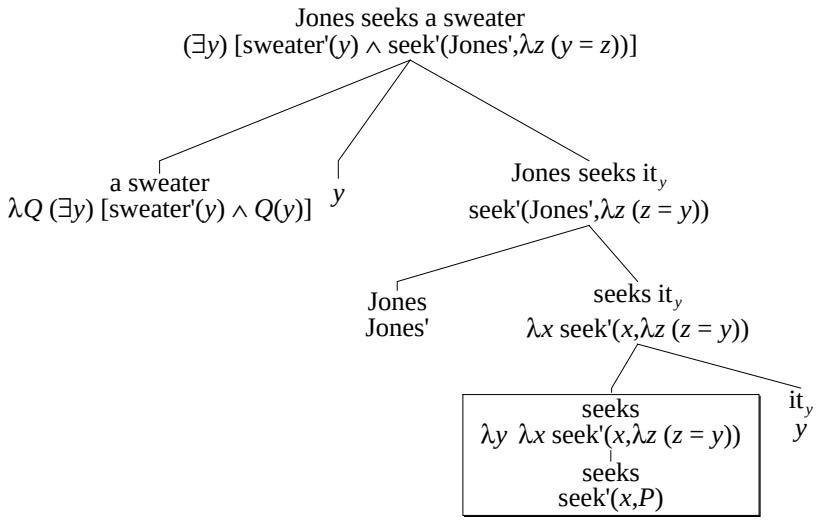
These two mechanisms lead to the same result when applied to simple search reports like the – now specifically interpreted – premiss of (1):

(67)



[49] I am ignoring a treatment of specificity in terms of lexical indeterminacy discussed in Zimmermann (to appear).

(68)



The highlighted portion of (67) shows how Essential Lifting (65) turns the individual-denoting trace variable '*y*' into a property term denoting the *essence* of an individual – the property of being identical to the individual denoted by '*y*'. In (68), Argument Lowering (66) has been applied to the opaque verb, leading to a binary first-order relation. Obviously, the result is the same. However, familiar arguments show that it is inadequate.[50] According to (67) or (68), Jones's goal is to find a specific individual; but for this to be the case, he would have to be acquainted with that individual's essence, which is beyond human capacity. Still, the specific reading may well be true, or so it seems. But then we will not bother to give a more careful formulation of its truth conditions here. Let it only be mentioned that it requires the type shift to occur with the verb, not the object (trace). The analyses of specific readings below will thus be formulated in terms of Argument Lowering; though equally inadequate, it lends itself more easily to repair than Essential Lifting.[51]

One of the most striking differences between the specific and the underspecific reading is that, unlike the former, the latter blocks the inference pattern of *Existential Impact*:

(∃) *x* is looking for a *P*.
∴ There is at least one *P*.

Both the failure and the correctness of (∃) are readily explained. On the underspecific reading of the premiss, (∃) fails because a sub-property *Q* of *P* that testifies the premiss need not be instantiated; it just has to match Jones's needs. On the specific reading, though, the individual that testifies the premiss must satisfy two conditions: its essence must match Jones's needs, but it must also itself instantiate *P*; in particular, then, it would have to be a witness to the conclusion. This difference between the two readings would be brought out more clearly in a logical notation that marks substitution resistance: in the formalization of the underspecific reading, *P* occurs intensionally; its position in the specific reading is purely extensional. In that respect the present analysis follows the usual explanation of the ambiguity in terms of scope.

4.2 Definite Descriptions

So far we have only considered indefinites as objects to opaque verbs. Yet, as Quine has already observed,[52] definite descriptions appear to give rise to ambiguity too:

(69) Jones is looking for the boss.

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50 See Lewis (1981) for relevant considerations.

51 See Section 3 of Zimmermann (to appear), where a reformulation of Argument Lowering along the lines of Kaplan (1969) is given.

52 Quine (1960: 152).

According to one construal of (69), Jones's search is directed at the property B of being the unique individual that is identical to the boss (of a contextually given business). According to another construal, he would be looking for a particular person, and the speaker identifies that person as the unique individual that happens to have property B without Jones necessarily knowing this. Interestingly, on the second construal, but not on the first one, the object of (69) may be replaced by a co-extensional description *salva veritate*. It is therefore natural to extend the ambiguity between underspecific and specific readings to definite descriptions as objects. Indeed, according to the Russellian account (70),[53] definite descriptions *are* existential quantifiers, viz. ones coming with particular uniqueness restrictions:

(70) $\text{the}' = [\lambda P\, \lambda Q\, (\exists y)\, [(\forall z)\, [P(z) \leftrightarrow (z = y)] \wedge Q(y)]]$

One may thus expect the following Russellian explication of the perceived ambiguity:

(71) $(\exists P)\, [P \leq [\lambda y\, (\forall z)\, [\text{boss}'(z) \leftrightarrow (z = y)] \wedge \text{seek}'(\text{Jones}', P)]]$ underspecific

(72) $(\exists P)\, [P \sqsubseteq [\lambda y\, (\forall z)\, [\text{boss}'(z) \leftrightarrow (z = y)] \wedge \text{seek}'(\text{Jones}', P)]]$ specific

(71) and (72) are indeed adequate formalizations of (69), provided that seek' is construed according to the exact match analysis (61). In the case of (72), I cannot fully substantiate this claim, because that would involve a more differentiated analysis of attitudes *de re* than the above naive treatment allows for. On the other hand, it is easy to see that (72) is true just in case there is precisely one boss and the corresponding indefinite report (69') is true according to the construal given in the previous subsection. Hence any improvement of that approach to specificity should carry over to (72), provided the latter comes out as the specific reading of (69).

(69') Jones is looking for a boss.

Concerning (71), one may wonder whether quantification over less general properties than unique identifications is really needed to account for reports on non-specific searches. However, the close analogy to the interpretation of indefinites pays off once we consider unspecific objects that are not instantiated in the actual world. Here is a pertinent scenario. Suppose Jones goes to a bar and meets a lady who he feels attracted to and therefore would like to see again. Due to some misunderstanding, he erroneously believes her to be the boss of the company he wants to make business with; as a matter of fact it is worker-owned. On the following day, when paying a visit to the company, his first objective is to find the boss. (69) is clearly true of this scenario, and certainly not on its specific reading (72). But note that under the circumstances, it is not true that Jones is engaged in a search that is successful just in case he finds the (one and only) boss of the company: all his success-indices are such that the boss he finds is the lady he met the night before, and hence a possible situation in which he finds the boss who happens to be a bearded hag would not be what he is after. Hence there is no perfect match between Jones's goal and the property of being the boss. Rather, his search aims at finding the lady boss who he has met the night before, who has a certain outward appearence, a pleasant voice, etc. In other words, the possible situations that satisfy his desires are such that he finds someone who instantiates a sub-property of being the boss – just as the underspecific reading (71) would have it.

So (71) and (72) are the readings of (69) that we are heading for. However, whereas (72) can be directly derived by inserting the Russellian formula (70) into the specificity construal given in the previous subsection, (71) is not the exact analogue of the underspecific reading – at least not if the Russellian determiner applied to properties as if they were individuals:

(73) $\text{the}' = \lambda \mathfrak{P}\, \lambda \mathfrak{Q}\, (\exists P)\, [(\forall Q)\, [\mathfrak{P}(Q) \leftrightarrow (Q = P)] \wedge \mathfrak{Q}(P)]$

When applied to (69), the domain-shifted Russellian determiner (73) yields (74), which is clearly inadequate because it implies that boss' has no proper sub-properties (like being a mean boss):

[53] Russell (1905). I am relying on the generalized quantifier version due to Montague (1970: 393).

(74) the'($\lambda P\ P \sqsubseteq$ boss') (λP seek'(Jones',P))
$\equiv$ $(\exists P)\ [(\forall Q)\ [Q \sqsubseteq \text{boss}' \leftrightarrow (Q = P)] \wedge \text{seek}'(\text{Jones}',P)]$

In order to obtain (71), the uniqueness condition must apply on the individual level, not the property level, and it must apply to the original restrictor of the noun. This could be achieved by brute force, e.g. by the following rather oulandish type adaptation:

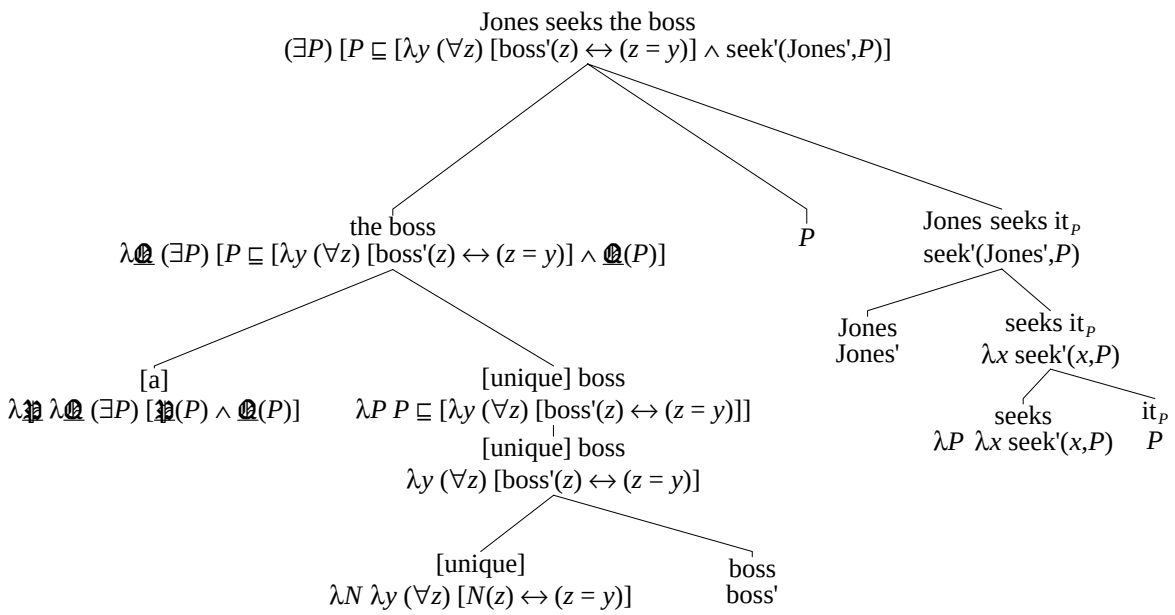
(75) the' =
$\lambda\mathfrak{P}\ \lambda\mathfrak{Q}\ (\exists N)\ (\exists P)\ [(\forall Q)\ [\mathfrak{P}(Q) \leftrightarrow (Q \sqsubseteq N)] \wedge P \sqsubseteq (\lambda y\ (\forall z)\ [N(z) \leftrightarrow (z=y)]) \wedge \mathfrak{Q}(P)]$

Using (75), (73) comes out as equivalent to (71) indeed:

(76) the'($\lambda P\ P \sqsubseteq$ boss') (λP seek'(Jones',P))
$\equiv$ $(\exists N)(\exists P)[(\forall Q)[Q \sqsubseteq \text{boss}' \leftrightarrow Q \sqsubseteq N] \wedge P \sqsubseteq (\lambda y\ (\forall z)\ [N(z) \leftrightarrow (z = y)]) \wedge \text{seek}'(\text{Jones}',P)]$
$\equiv$ $(\exists N)\ (\exists P)\ [N = \text{boss}' \wedge P \sqsubseteq (\lambda y\ (\forall z)\ [N(z) \leftrightarrow (z = y)]) \wedge \text{seek}'(\text{Jones}',P)]$

However, there are a more natural ways to achieve the same result. Instead of treating the definite article as a quantifier, it may be interpreted as forming individual concepts. Since this 'Fregean' strategy is at odds with the present 'Russellian' interpretive framework,[54] I leave the details to the reader. As an alternative strategy, one may analyze the definite article as an existential determiner that applies to properties that have undergone a uniqueness test.[55] Although the details of such an analysis are beyond the scope of this paper, the following tree indicates how the problematic underspecific reading (71) may be derived:

(77)



The idea is that the higher-order version (73) of the definite article is split into two components: uniqueness, which applies directly to the property lexically expressed by the noun *boss*; and second-order existence, which applies to the property of being the unique boss after it has undergone Property Lifting (48). The fact that a type shift may intervene between these two components, thus destroying the lexical integrity of the definite article, may be seen as an indication for its abstract, grammatical status – or else as evidence for the Fregean strategy explored in the Appendix.

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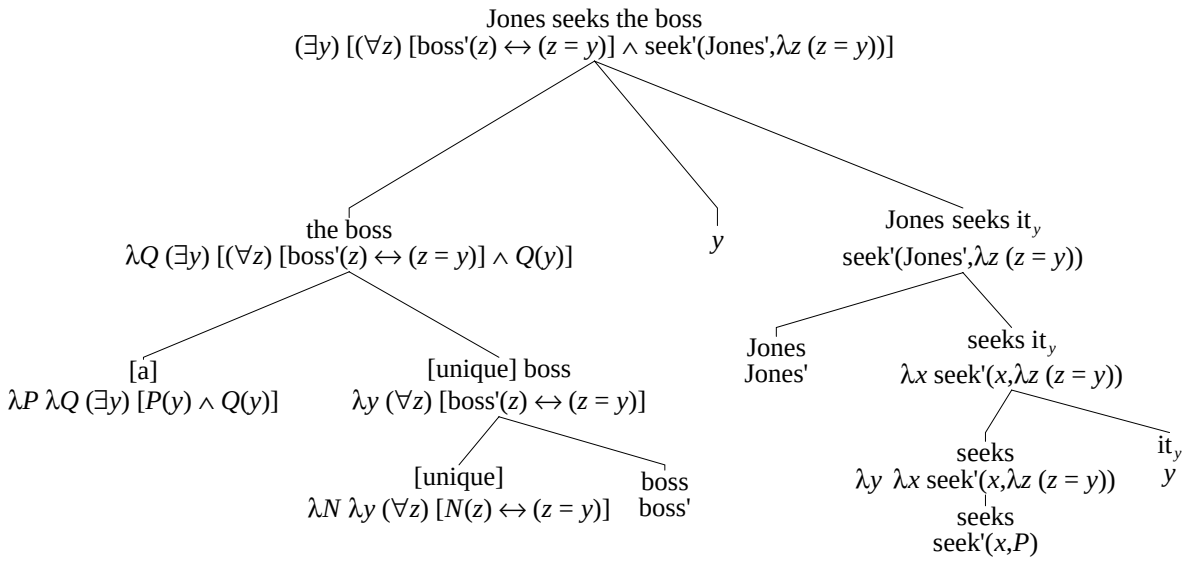
54 In the present framework the only index-dependet objects are the truth values of propositions (cf. fn. 10), which is why there are no individual concepts. Kaplan's (1975) method of transposing Frege-Churches (with individual concepts) to Russellia (the land of no individual concepts) does not preserve types and is thus of no help here.

55 In a more thorough treatment of definite descriptions one could implement this test as a presupposition. However, since I want to steer clear from the projection problem, uniqueness and existence will be dealt with conjunctively, in the spirit of Russell (1905).

Another combination of existence and uniqueness, leads to the desired specific reading (72):

(78)



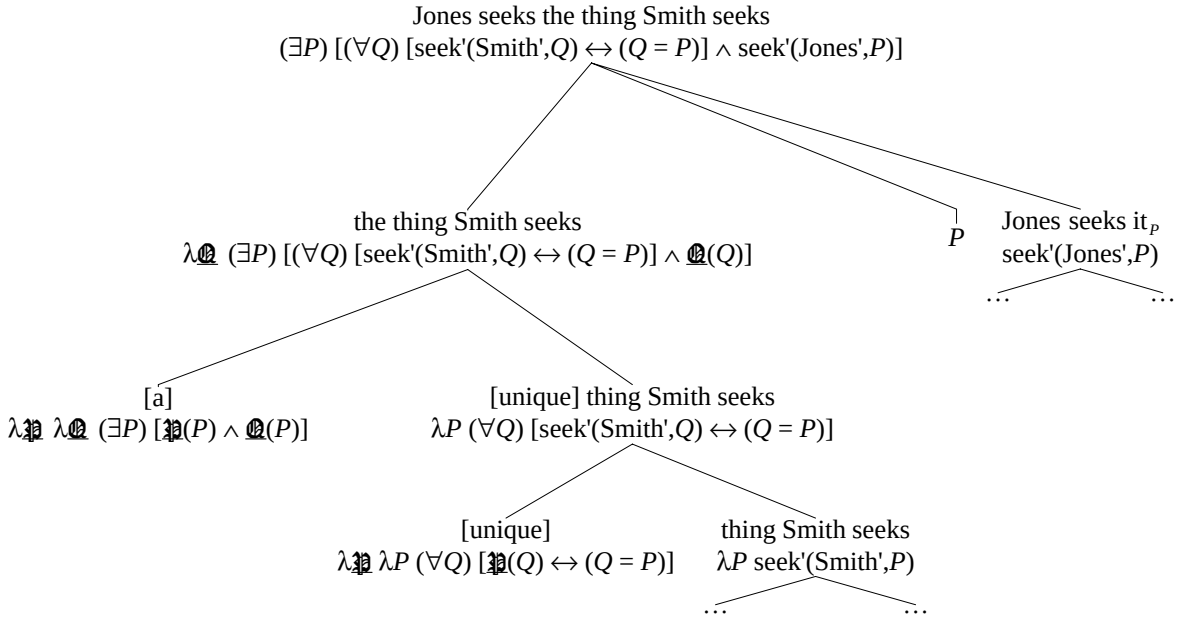
Hence, as in the case of indefinite objects, the difference between specific and unspecific reading is not a matter of scope but a result of Property Lifting the noun (modified by uniqueness) and type-adapting the (implicit existential) determiner.

A third combination of the same meaning components is required for the near-paraphrase (79) of the reading of (18) that gave rise to the Monotonicity Problem:

(18) Jones is looking for something Smith is looking for.
(79) Jones is looking for the thing Smith is looking for.

In the relevant reading (79) is true if both Smith and Jones are performing a search for an unspecific sweater and Smith is not performing any other search. Such a reading would obviously have to be obtained by a domain-shited variant of the definte article. However, the most obvious candidate will not do the job:

(79)



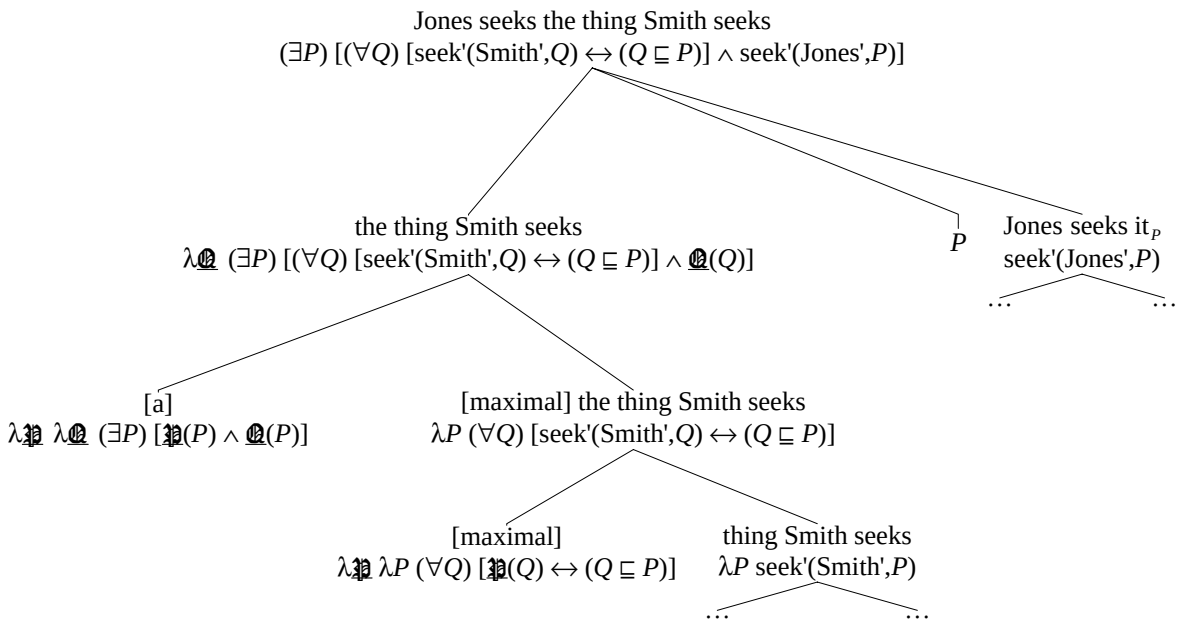
(79) adapts the higher-order construal (73) of the definite article to the above strategy of separating existence from uniqueness. But with or without this split, uniqueness is the problem. For even if Smith is performing a single search act, there will be a host of properties to which he stands in the *seek*-relation. For instance, if the relation holds between Smith and the property

of being a sweater, it will also hold between him and being a sweater found by him, being a sweater that he possbibly finds, being a sweater found by someone, etc.[56] Hence uniqueness is out of question. However, it is well known that uniqueness as a component of the definite article is problematic for independent reasons and should be replaced by an appropriate notion of *maximality*, either with respect to contextual salience, or in terms of mereological ordering.[57] Since we have been relying on the Boolean ordering $\sqsubseteq$ among properties all along, it is only natural to try and employ it as determining (mereological) maximality. What, then, will be the maximal property to which Smith stands in the *seek*-relation? In fact: will there be such a maximal property at all – again provided that Smith is not engaged in more than one search? If, say, he would content himself with any sweater whatsoever, one may expect the property of being a sweater the maximal object of his search. The expectation is borne out, due to the following general characterisation of maximal (unspecific) objects of search:

(80) For any world w, time t, individual x, and ε that is the only search act performed by x in w at t, there is property M such that:
- if x finds anything with property M at an index (w',t'), then $(w,t)\ T_x\ (w',t')$;
- $[\![\text{seek}']\!]\ (M)\ (x)\ (w,t) = 1$
- $P \sqsubseteq M$, whenever $[\![\text{seek}']\!]\ (P)\ (x)\ (w,t) = 1$

I leave the verification of (80) to the reader[58]. It should be obvious that the maximal property turns out to satisfy the relation underlying the success-oriented analysis (62b) of *seek*; in fact, the maxima of the two relations are the same. On the other hand, the Quine + Hintikka analysis does not lend itself to Boolean maximalization: due to its built-in upward monotonicity, the maximal object of any search whatsoever will be the property of being self-identical, thus trivializing the proposition that would be expressed by statements like (79), expressing that both Jones and Smith are engaged in some search act or other. We thus arrive at the following revision of (79):

(79+)



56 These implications hold for all three lexical analyses considered here. To my knowledge, the only strategy to avoid them is the varying atitudes approach (11), according to which, in principle, being a sweater may trigger a different accessibility relation than being a sweater found by Jones etc.

57 Lewis (1979b) and Sharvy (1980) are respective *loci classici* of the two notions of maximality. One could also try a mixed strategy of combining salience and Boolean ordering, as Sharvit (1999) does in her analysis of headless relatives.

58 (80) can be proved by having M assign to any individual y the chararacteristic function of the following set of indices: $\{(w't') \mid x$ does not find y in w' at t', or else $(w,t)\ T_x\ (w',t')\}$. The proof makes use of the Seeking Postulate (SP) from Section 3.4.

(79⁺) is only true if Smith and Jones are after *exactly* the same thing, which is extremely unlikely. Still, a statement of (79⁺) would count it as true if whatever satisfies Smith is close enough to whatever satisfies Jones. I suspect that this is laxness is a consequence of semantic improbability and that it can be dealt with in terms of a general theory of tolerance in identifying abstract objects.[59]

4.3 Bare Plurals

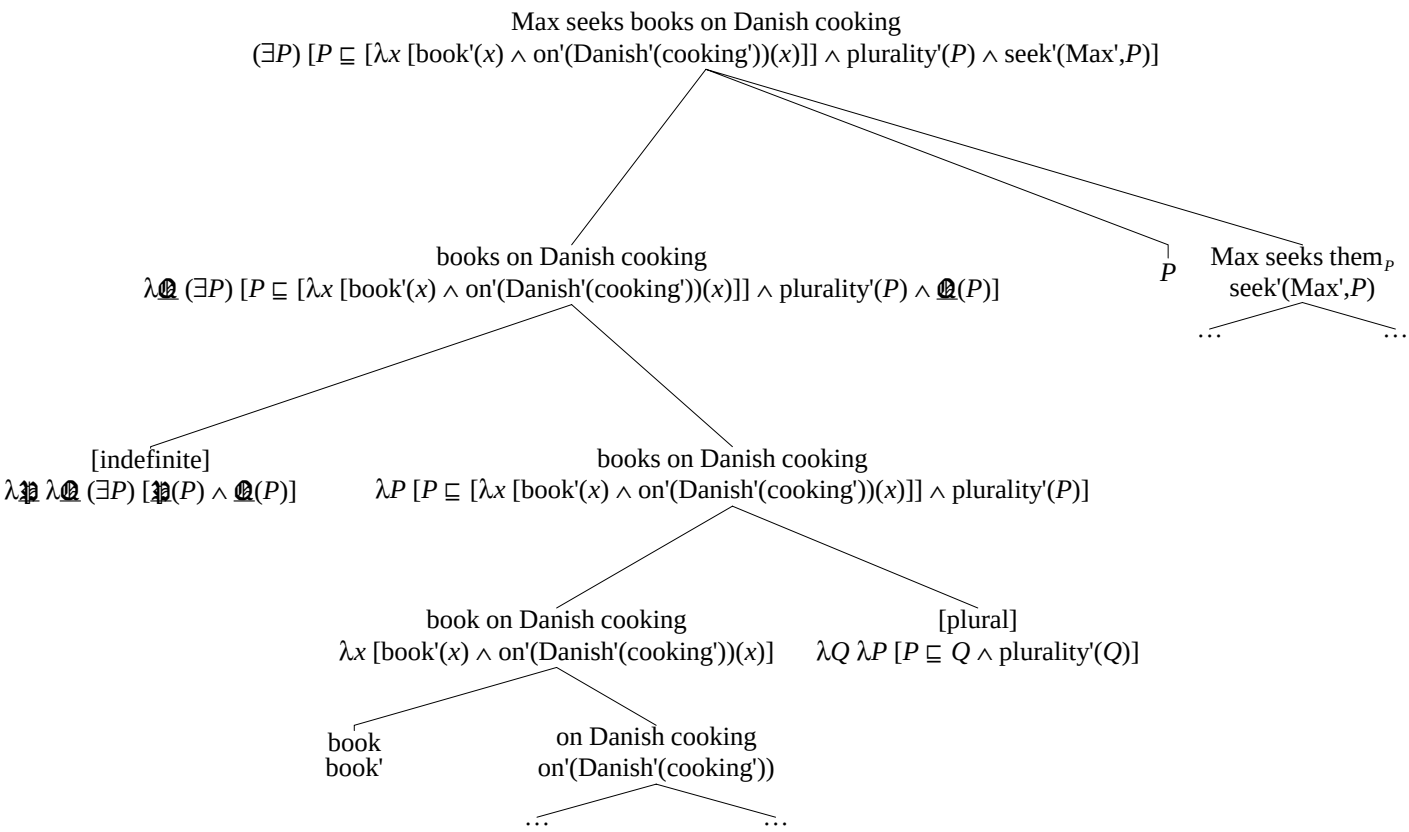
In his dissertation, Greg Carlson pointed out a surprising asymmetry between singular indefinites and bare plurals:[60]

(81a) Max is looking for a book on Danish cooking.
(b) Max is looking for books on Danish cooking.

Like (81a), (81b) has a non-specific reading; in fact, the two readings are hard to tell apart. This observation appears to speak in favour of a traditional analysis of bare plurals as the plural analogues of singular indefinites. However, in contrast to (81a), (81b) does not have a specific reading.

The present approach to opacity offers a natural explanation of Carlson's asymmetry. It turns on the exact type assignment. If singular indefinites express existential quantification over individuals, then plural indefinites ought to be existential quantifiers over pluralities of individuals. What, then, is the type of a plurality of individuals? If pluralities of individuals were themselves individuals, then bare plurals would be of the same type as singular indefinites and thus ought to induce the same ambiguity. If, on the other hand, pluralities were properties of individuals (with sets of individuals as their extensions), then bare plurals could quantify over the object argument of an opaque verb. This suggests the following account of (81b):

(82)



59 Lasersohn's (1999) *pragmatic halos* might be a suitable tool.
60 Carlson (1977: 9), example (10); I omitted the emphasis on the opaque predicate.

Given the obvious interpretation (83) of the second-order predicate plurality' implicit in the interpretation of the plural feature, (82) is very close to the underspecific reading of (81a) indeed – the only difference being that the success indices of Max's search must not contain situations in which he finds one book only:

(83) plurality' = $\lambda P \Box (\exists x) (\exists y) [P(x) \wedge P(y) \wedge x \neq y]$

As far as I can see, (82) is the only interpretation availble for (81b) given the semantic mechanisms employed so far. In particular, there is no analogue to the specific reading of (81a), because the pluralized noun phrase cannot bind an individual trace in the predicate.

Three features of this solution to Carlson's puzzle may arouse suspicion. First, contrary to a frequently made assumption in plural semantics, the distinction between pluralities and individuals must be reflected on the level of the logical types that take care of semantic combination; secondly, bare plurals do not denote kinds or properties, but express existential quantification; thirdly, pluralites are characterized intensionally, i.e. their extensions vary across indices. The first feature is vital to the solution and I cannot offer any independent evidence for it. Future research will have to show whether the singular/plural distinction in terms of types is as viable as its more popular rival in terms of a sortal distinction invisible for type-driven mechanisms.[61] Finally, the intensionality of pluralities may appear an artefact of the present, proposition-based framework that does not have a separate type for sets (of individuals). However, I suspect it is not. In fact, supportive evidence for the need to intensionalize pluralities may be gained from the semantics of *different*, where a purely extensional account of pluralities runs the risk of trivialization.[62] On the other hand, the present approach can still cope with the following sentence [the German equivalent of] which was presented as a counter-example to Carlson's kind-based analysis of bare plurals[63]:

(84) Hans wanted to put belladonnas into the fruit salad, because he mistook them for [real] cherries.

Let me simplify the example a little bit in order to avoid irrelevant compliciations:

(85) Hans wants to eat belladonnas and Hans mistakes them for cherries.

According to an obvious construal, the first conjunct of (85) reports Hans's desire to be directed at situations in which there are (at least two distinct) belladonas that he eats:

(86) want'(Hans',$(\exists x) (\exists y)$ [belladonna'(x) $\wedge$ belladonna'(y) $\wedge$ $x \neq y$ $\wedge$ eat'(Hans',x) $\wedge$ eat'(Hans',y)])

As it turns out, (86) can be derived within the above approach to bare plurals, using standard devices of meaning combination:

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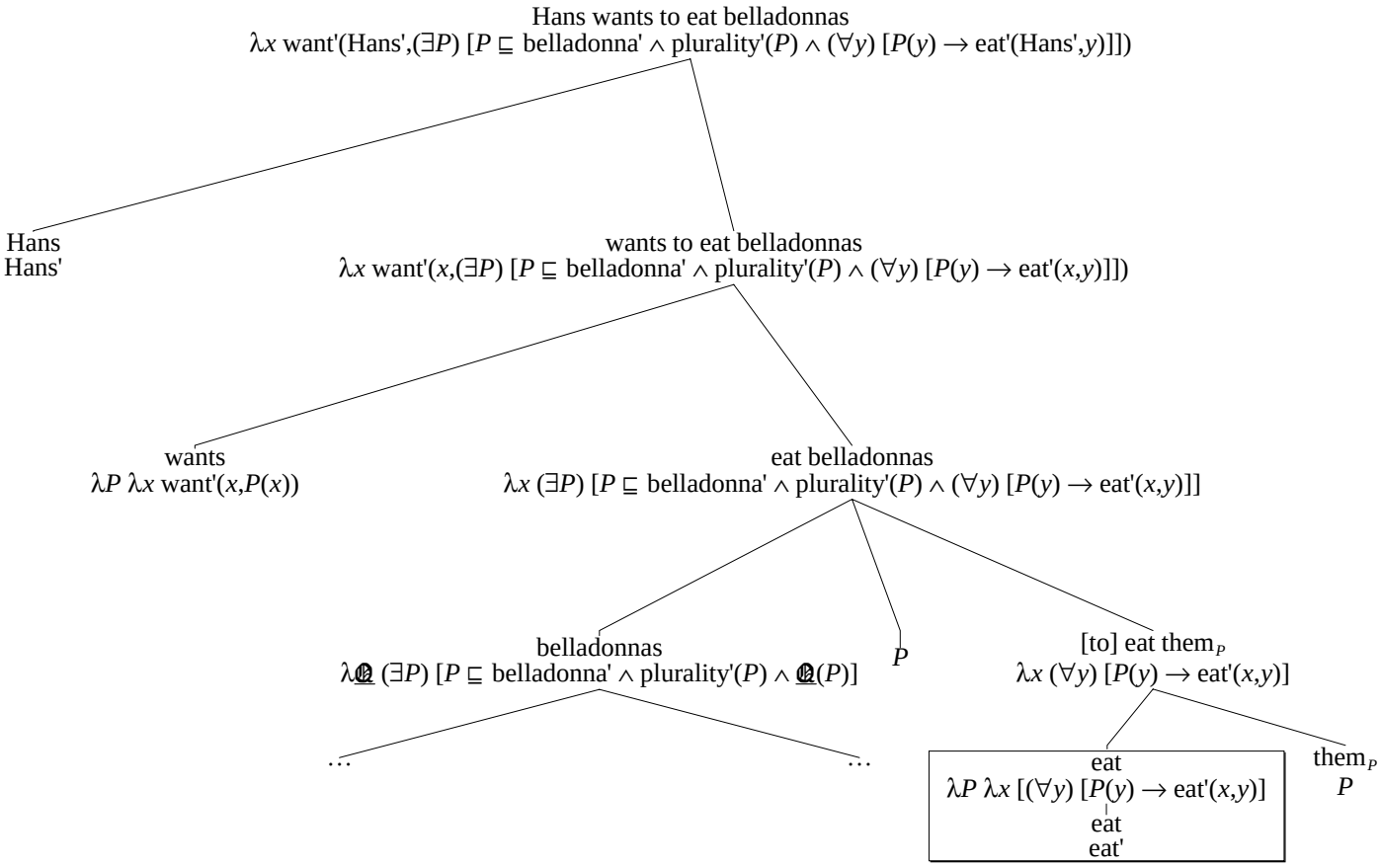
61 Of course, the suggestion to reflect plural formation in the type structure is not new. It is, e.g., crucial in Yoad Winter's (2001) Boolean treatment of non-Boolean conjunction.

62 In Sigrid Beck's (2000: 122) treatment of *Frank and Bärbel read different books* [= her (60a)], the domain of books must be split into two pluralities – the books read by Frank, and those read by Bärbel – about which the sentence expresses distinctness. This proposition is only contingent if the pluralities are characterized intensionally.

63 Kratzer (1980: 48), ex. (4). The bracketed epithet 'real' translates German *richtigen*, which was apparently inserted for contrastive emphasis, the German equivalent of *belladonnas* [*Tollkirschen*] literally meaning *mad cherries*. The German original of (84) reads: *Hans wollte Tollkirschen in den Obstsalat tun, da er sie mit richtigen Kirschen verwechselte.*

(87)



In (87) the bare plural *belladonnas* is analyzed in analogy to the object in (82) above, i.e. as a quantifier over properties [type ((*et*)*t*)*t*]. Since it occupies the object position [*e*] of the transparent verb *eat*, it cannot be interpreted *in situ*; neither can the trace [*et*] that it leaves after quantifier raising. In order to resolve the type conflict, one can apply a similar strategy as in the *de re* construal (68) in Section 4.1: quantifier raising of the object and type adjusting the argument position of the verb so that it will be applicable to the trace. However, whereas the shift (66) lowers the opaque argument type *et* to the trace type *e*, the shift (88) highlighted in (87) goes in the opposite direction:

(66) *Argument Lowering*
From $\Re$ of type (*et*)(*et*) to [$\lambda y\ \lambda x\ \Re(x,\lambda z\ (z = y))$] of type *e*(*et*)

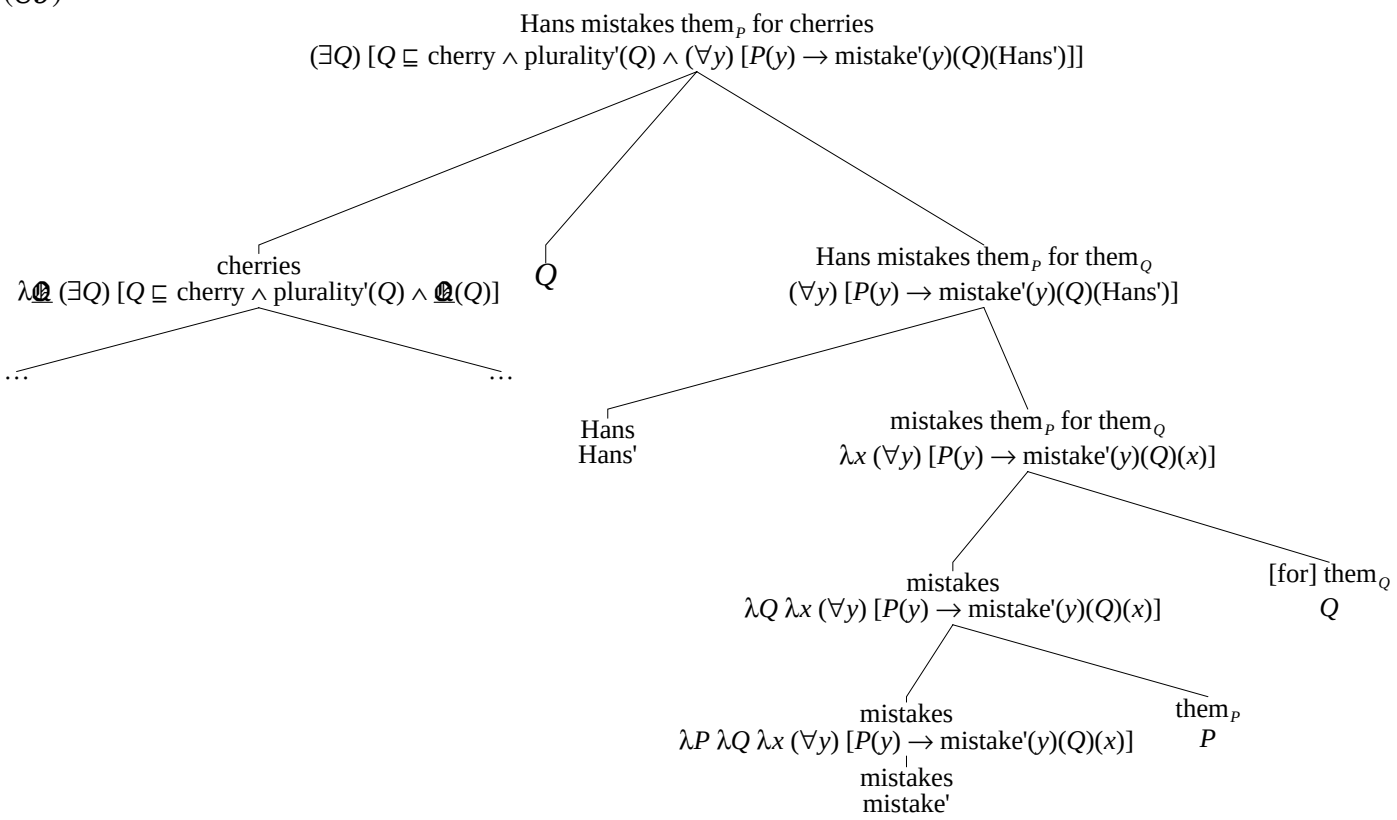
(88) *Distribution*
From *R* of type *e*(*et*) to $\lambda P\ \lambda x\ [(\forall y)\ [P(y) \rightarrow R(x,y)]$ of type (*et*)(*et*)

Some sort of distribution mechanism is employed in any semantic account of plurals; the present approach invites an implementation as a means of type-coercion. Morover, the semantic mechanism responsible for extracting the bare plural from the infinitival clause in (87) is a straightforward generalization of quantifier raising.[64] It is readily verified that the resulting formula is equivalent to (86).

Straightforward though the account (87) may be, it is not the reading that is relevant in the context of (85), where the indefinite is picked up anaphorically in the second conjunct. Rather it seems that the anaphoric dependence of the second conjunct of (88) necessitates a wide scope construal of the indefinite in the first conjunct. In other words, the object must be allowed to rise to a position from where it can bind the pronoun in the second conjunct which, consequently, should be treated along the following lines:[65]

[64] Cf. Montague (1973: 234), T16. Alternatively, one may represent the infinitival subject in Logical Form and apply ordinary quantfier raising; cf. Heim & Kratzer (1998: 217ff.).

(89)



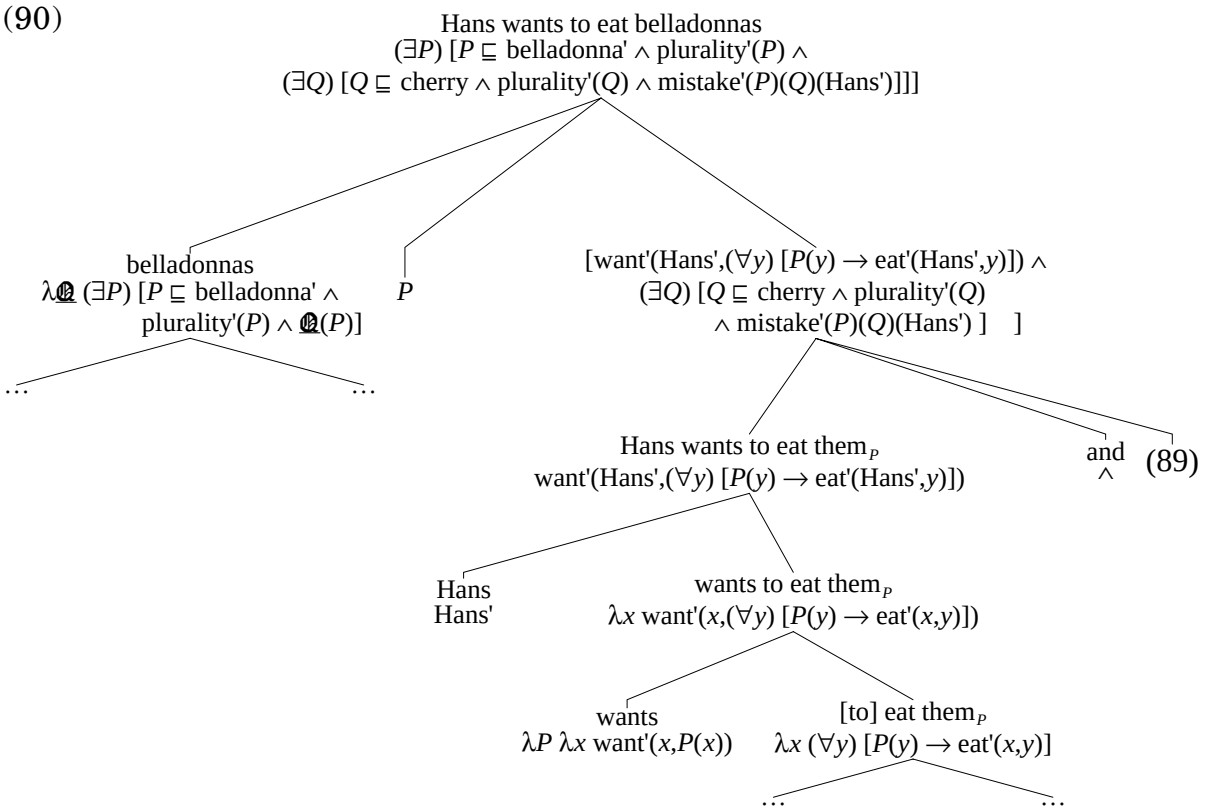
In (89), *mistake [for]* is taken to be opaque with respect to its prepositional object position. The following equation gives a rough idea of its lexical meaning:

(90) $\text{mistake}' = \lambda y\ \lambda P\ \lambda x\ [\text{believe}'(x,P(y)) \wedge \neg P(y)]$

A more adequate account would treat the second conjunct in the matrix of (90) as presuppostional, but since I want to avoid projection problems, I will leave it at that.[66] In order to arrive at an analysis of (the relevant reading of) the conjunction (85), some discourse anaphoric mechanism is called for. As announced, I will simply raise the bare plural the first conjunct out of the conjunction, even though it ought to be possible to give a more adequate formulation within a dynamic theory:[67]

65 The distribution mechanism employed to the direct object position of *mistake* in (89) is an obvious type-adaptation of (88).
66 A more adequate account would also employ a *de re* construal in distributing the property over the belief context.
67 Heim (1982), Kamp & Reyle (1993).

(90)



According to this analysis, (85) may apply to a situation in which the protagonist's desire is directed at the belladonnas he has before him and which he takes to be cherries. More specifically, the property of being a belladonna that Hans sees in that situation could be a witness to the existenial claim expressed by [the topmost formula in] (90), viz. that he wants to eat the things with that property and that he erroneously believes of the things with that property that they are cherries. I take this to be a welcome result. Moreover, given the distributive *de re* construal (89) of the second conjunct of (85), the matrix of (90) is unlikely to be satisfied by highly general sub-properties of the denotation of *belladonna*: in order for Hans to have a belief about each single representative of that property, he must somehow be acquainted with all of them, as would be the case if he has them in front of him, but not, say, if he only read about them in a botany text.[68]

4.4 Other Quantifiers

So far we have looked at objects of opaque verbs that express existential quantification: singular indefinites, definite descriptions, and bare plurals. Let us now see how the present analysis applies to other cases of quantified noun phrases. Starting with the specific readings, it is important to notice that they depend on the type shift (66) applied to the opaque verb, which makes it susceptible to the quantification expressed by its object:

(66) *Argument Lowering*
From $\Re$ of type $(et)(et)$ to $[\lambda y\ \lambda x\ \Re(x,\lambda z\ (z = y))]$ of type $e(et)$

Whether the application of (66) is freely generated or triggered by the type conflict between the verb and its object, it should occur with all kinds of quantified objects, which one would therefore expect to trigger specific readings too. This expectation is borne out, as the following examples illustrate:

(92) Jones is looking for each sweater.
(93) Jones is looking for most sweaters.

[68] A similar effect could be achieved by treating the direct object position of *mistake* as opaque and generalizing the *de re* construal to properties. Something along these lines is suggested by McNally & van Geenhoven (to appear).

As can be verified (not here though) by modifying the derivation (68) given in Section 4.1, the above approach to specificity assigns the following readings to (92) and (93) without any further ado (other than adding the standard interpretations of the determiners):

(92') $(\forall y)$ [sweater'(y) $\rightarrow$ seek'(Jones',λz ($y = z$))]
(93') (most') (sweater',λy seek'(Jones',λz ($y = z$))]

Given the simplified *de re* construal (66), these formulae are as close as they could be to the specific readings of (92) and (93).

As has been observed before[69], sentences like (92) and (93) lack a non-specific reading. In order to see how the present approach to opacity can cope with this fact, it ought to be realized that, according to it, the only form of non-specificity is underspecificity, and that underspecificity comes about whenever the object quantifies over properties. In the case of (92) and (93) this can only happen as the result of some sort of re-interpretation or coercion process. For, unlike bare plurals, the objects are ordinarily understood as quantifying over individuals. In this respect they are similar to singular indefinites the underspecific readings of which depend on a type shift (48) applied to their nominal head and an alternative interpretation (49) of the indefinite article:

(48) *Property Lifting*
From N of type et to $[\lambda P\ P \sqsubseteq N]$ of type $(et)t$
– or, equivalently, to: $\lambda P\ (\exists Q)\ P = [\lambda x\ N(x) \wedge Q(x)]$

(49) $a' = \lambda \mathfrak{P}_q\ \lambda \mathfrak{Q}_q\ (\exists P_{et})\ [\mathfrak{P}(P) \wedge \mathfrak{Q}(P)]$

The type shift (48) appears to be independently available; evidence for this will be given in Section 5.1. Hence the present approach to opacity assigns underspecific readings to (92) and (93) just in case the determiners *each* and *most* allow for higher-order interpretations in analogy with (48). Since any non-specific readings of these sentences ought to be blocked for the sake of observational adequacy, the obvious move is to restrict the interpretation of non-existential determiners to the type $(et)t$, which is what I propose. In other words, unlike singular indefinites, the objects in (92) and (90) do not trigger underspecific readings, because they cannot be interpreted as quantifying over properties.

This policy may create an impression of adhockery: after all, what is the difference between re-interpretations of nouns (49) or verbs (66) on the one hand, and the alternative interpretation (49) of the indefinite determiner? In fact, since the latter is only envoked to avoid a type clash, it too could be understood as the result of a type-adaptation process. I think this reasoning is not correct. Let me explain.

The ordinary interpretation of the indefinite determiner is as an existential quantifier over indiviuals:

(94) $a' = \lambda P_{et}\ \lambda Q_{et}\ (\exists y_e)\ [P(y) \wedge Q(y)]$

Despite the obvious similarity between (49) and (94), it is unlikely that the former is the result of any *type* shift applied to the latter. Rather, what is shifted is the *domain* of quantification and not (just) the type.[70] The type shifts found in coercion processes are logical operations applying to objects in a type hierarchy and embedding them into a different domain. Like the shifts in (66) and (48), they are themselves objects of the (functional) type hierachy and typically definable by (closed) type-logical formulae. However, no function that maps determiner denotations of type $(et)q$ to objects of type $q(qt)$ can just replace the quantificational domain of individuals by properties, at the same time preserving the quantificational force of all determiners. For although there are type-logically definable functions that have the

[69] Zimmermann (1993: 160f.).

[70] Cf. van Benthem's (1995, ch. 13) distinction between derivational and variable (or substitutional) polymorphism. According to Hamm & Zimmermann (2002: 155ff.), the confusion between type shifts and domain shifts is partly responsible for the infamous *proportion problem* of early versions of dynamic semantics.

denotation given in (49) come out as the value of the ordinary denotation of the (singular) indefinite article in (94), none of them will do exactly the work of the simple domain shift suggested by the logical notation. In fact, when it comes to domains of different cardinalites, domain shifting is not even a function.[71] I conclude that the denotation given in (49) is not the work of a type coercion mechinsm. This leaves the possibility that the indefinite article is genuinely ambiguous or, alternatively, that it is indeterminate. I will leave this question open.

5. Further Issues

5.1 Representations

One of the main ingredients of the derivation of the underspecific readings of opaque verbs is the type shift (48) that has the lexical noun of the object denote a second-order property. There is evidence that Property Lifting also occurs in other environments, including the following puzzling case:[72]

(95) The advertising agency are looking for an article of clothing.

(95) may be used to describe a situation in which the boss's fur coat disappeared and the agency feels responsible for bringing it back; this would be the specific reading. (95) may also be applied if a shivering model is waiting for a shooting and keeps everyone busy; this would be the underspecific reading. More interestingly, (95) may also be used when the agency wants to start a sponsoring campaign and put their customer's logo on a everybody's tee shirts, or everybody's caps, or everybody's sweater, or whatever is most suitable – which is precisely what they want to find out. Obviously, this kind of situation may be truthfully described by (95), but it is not covered by the specific or the underspecific reading: there is no particular item that is missing; and finding any such item could not end the search. What the agency is after in such a case – what they want to *find* – appears to be an unspecific object. This intuition is corroborated when we consider a situation in which the agency, after a long a careful search, finally decides on loden coats as an advertising medium. Under such circumstances (96) would be true even though what the agency found was not a *specific* piece of clothing:

(96) The advertising agency found an article of clothing.

It would thus seem that, in order to analyze (95) and (96), the relations expressed by *seek* and *find* would have to be generalized so as to hold between individuals and properties of unspecific objects. However, a less cumbersome analysis ensues once one recognizes that finding an unspecific object amounts to finding a representative, a description, or more generally: a *representation* of that object.[73] The fact that in (96) the noun *article of clothing* can be used to refer to representations of kinds of articles of clothing can then be seen as the result of the combined efforts of two independent semantic mechanisms, Property Lifting (48) and:

(97) *Representational Reading*
From N of type et to $[\lambda y \text{ representation}'(y,N)]$ of type et

Obviously (97) cannot be applied to resolve type clashes. It may be used to resolve sortal conflicts though. However, I suspect that its application is triggered by contextual cues and plausibility considerations, as in (98), where the noun *lion* may equally refer to animals and

[71] The following kind of formula defining a mapping from determiner meanigs $\mathfrak{D}$ of type $(et)q$ to binary quantifiers over properties is about as good as it gets:

(*) $\lambda\mathfrak{P}\,\lambda\mathfrak{Q}\,(\exists P)\,(\exists Q)\,[\mathfrak{P}(P) \wedge \mathfrak{Q}(Q) \wedge (P,Q) \approx (\mathfrak{P},\mathfrak{Q})]$,

where '$(P,Q) \approx (\mathfrak{P},\mathfrak{Q})$' expresses that the intersection and the relative complements of P and Q have the same respective cardinalities as those of $\mathfrak{P}$ and $\mathfrak{Q}$. (I leave the type-logical implementation to the reader.) Given the logicality and conservativity of determiner meanings (cf. Westerstahl 1989), (*) will suffice for cross-identifying certain determiner denotations including the binary existential quantifiers (94) and (49). However, it will not distinguish between (the quantifiers expressed by) *most* and *at least n+1*, where n is the (finite) number of individuals, mapping both to *at least n+1* as ranging over properties. And, as simple cardinality comparisons show, this mismatch is beyond repair.

[72] I am indebted to Fred Hoyt (p.c., 2002) for supplying this example.

[73] Cf. Zimmermann (to appear: Section 4.4), where similar cases are analyzed using representations of Montagovian unspecific objects, i.e. quantifiers.

pieces of hewn stone:

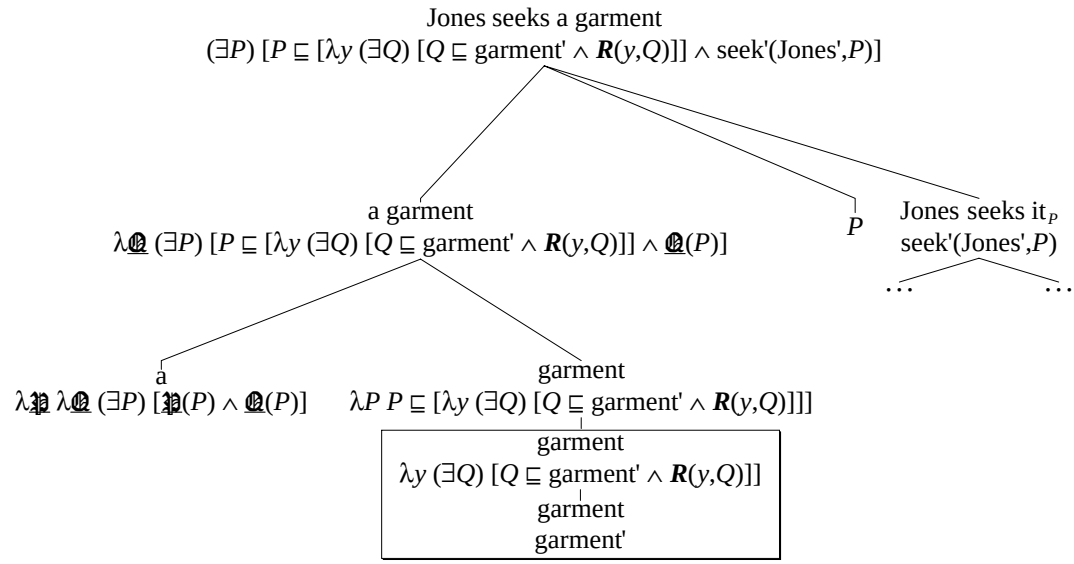
(98) There is a lion in front of the zoo.

A stone object witnessing (98) would have to have certain features that make it a representation of a lion. Typically, it would not be a representation of a particular lion, but of a certain type of lion. For instance, it may represent a male lion and would thus not be a representation of a female animal. Since the verb *represent* is opaque, this is just what the present analysis would lead one to expect: to represent a lion is to stand in a certain relation [of type $(e(et)t)$] to a sub-property of being a lion. Calling this relation $\boldsymbol{R}$, we may reformulate (97) as:

(97*) *Representational Reading*
From N of type et to $[\lambda y\ (\exists Q)\ [Q \sqsubseteq N \wedge \boldsymbol{R}(y,Q)]]$ of type et

Spelling out the truth-conditional details of the predication '$\boldsymbol{R}(y,N)$' is rather delicate and certainly beyond the scope of this paper.[74] What matters here is that (97*) can be put to use to arrive at an adequate account of (95) and (96). The following combination of (48) and (97*), yields the intended reading of [a simplified version of] (95):

(99)

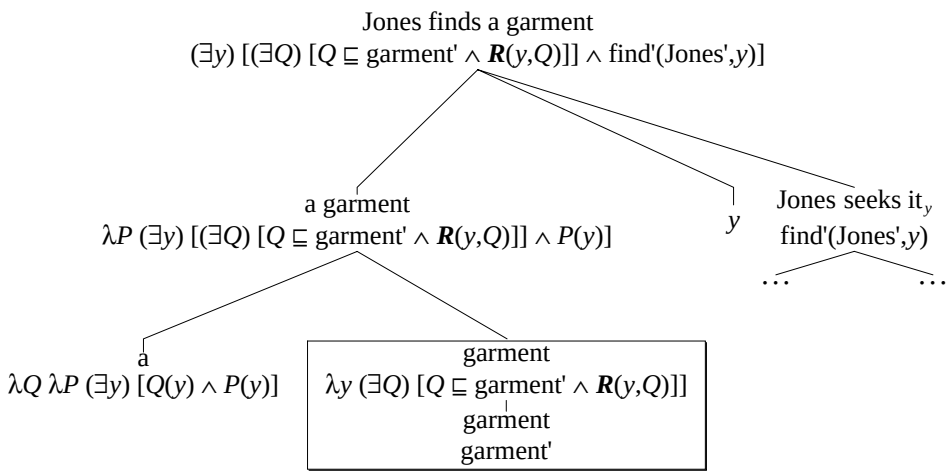


The highlighted part in (99) is where the (97*) transforms the property G expressed by *garment* into the property RG of being a representation of G, i.e. the property of representing a garment. In order to combine with the opaque verb *seek*, RG is then type-adapted in the by now familiar way, i.e. by Property Lifiting (48). In the end a reading results according to which there is a property of representations of garments such that the agency Jones are engaged in a search that is successful just in case they find something with that property. Note that, according to this construal, sub-properties come in twice: once in the application of (48), where a sub-property of RG – e.g. being a suitable phrase or depiction – determines the success-condition of the relevant search; and once in the application of (97*), where a sub-property of G – e.g. being a tee shirt or a loden coat – is what precisely the representation found would have to be a representation of.

It is obvious that (97*) may also be used to derive a reading of (96), where the object found by the agency is not a particular piece of clothing but a representation of some *kind* of garment. As observed above, (96) can be truthfully said of a situation in which the agency finally decided on a particular kind of garment like loden coats. And it would seem that the relevant reading could be obtained along the lines of (100):

[74] See Goodman (1969: ch.1), especially Section 6, for some relevant discussion. A fuller treatment would also have to take into account the subject-dependence of representations, which calls for a relational construal of unspecific objects (cf. fn. 11 above): a representation is always a representation *for* someone.

(100)



However, there is a problem with (100): if loden coats were Jones's choice, then why couldn't this be expressed by (101), which allows for a derivation parallel to (100)?

(101) The advertising agency found a loden coat.

I do not have an explanation for the unsuitability of (101). The only observation I can offer is that (96) and (101) are not quite parallel: the former has a reading that is true of the circumstances under discussion, while the corresponding construal of the latter is false. More specifically, as has been observed before,[75] the verb *find* has an *epistemic* reading according to which it reports on successful search reports. In the present framework, this reading can be captured by the following analysis of *find* as an opaque verb:

(102) *Lexical Analysis of Epistemic* find
For any property P, individual x, world w, and time t, the following holds:
$[\![\text{find}'_{epist}]\!]\ (P)\ (x)\ (w,t) = 1$ iff iff there is a time t^* ending with t and search act ε performed by x in w at t^* such that any worlds w' and times t' satisfy the following condition:

$(w,t^*)\ T_\varepsilon\ (w',t')$ iff the property of being found by x overlaps the extension of P at (w',t').

The idea behind (102) is that a sentence like (101) reports the agency to have found a loden coat *as the result of a search for a loden coat*. According to (101), in its (independently attested) epistemic reading, *find* is an opaque verb. Hence (96) and (101) may be analyzed in analogy to (99):

(96') $(\exists P)\ [P \sqsubseteq [\lambda y\ (\exists Q)\ [Q \sqsubseteq \text{garment}' \wedge \boldsymbol{R}(y,Q)]] \wedge \text{find}'_{epist}(\text{Jones}',P)]$
(101') $(\exists P)\ [P \sqsubseteq [\lambda y\ (\exists Q)\ [Q \sqsubseteq \text{loden-coat}' \wedge \boldsymbol{R}(y,Q)]] \wedge \text{find}'_{epist}(\text{Jones}',P)]$

Given the above scenario, (96') would be true, whereas (101') would not: the agency had not been looking for a kind of loden coat, but they had been looking for a kind of garment. This is as close as the present analysis of opacity gets to explaining why (101) is felt to be false under the circumstances.

5.2 Downward Monotonicity in Certain Verbs?

The analysis of opacity proposed here predicts that monotonicity is a matter of Logical Form. According to it, there are no opaque verbs that block upward monotonicity inferences, and *a fortiori* none that invite downward monotonicity inferences. However, the (transitive) verb *prevent* has been claimed to be precisely of the latter kind.[76] On the face of it, this appears unwarranted:

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75 Moltmann (1997: 47).
76 Condoravdi *et al.* (2001a: 164).

(103) Jones prevented a fire disaster.
(104) Jones prevented a disaster.
(105) Jones prevented a disastrous earthquake.

(103) may be true if Jones extinguished the flames before they could spread. Given such a scenario, there would not have been a particular disaster that Jones prevented; in fact, there might not have been any disaster whatsoever. So transitive *prevent* is clearly opaque, allowing for an non-specific reading of an indefinite object. Moreover it appears that (103) cannot be true without (104) being true, thus confirming the present analysis. And the same kind of scenario may be used to illustrate the falsehood of (105). In particular, then, (104) does not imply (105), i. e. downward monotonicity does not hold, as expected by the present analysis.

These observations notwithstanding, the direct object position of *prevent* appears to allow for *N*egative *P*olarity *I*tems:

(106) This device prevents the slightest downward movement.
(107) This device prevents any unwanted movement.

In fact, 'verbs of absence' appear to be NPI licensers in general, witness:

(108) The police are looking for any witnesses of the accident.
(109) The auditor was looking for the slightest inaccuracy in the balance.

Assuming the classical correlation between downward monotonicity and *NPI*-licensing[77], these data are surprising indeed. One explanation could be that the *local* context created by the verb *prevent* is downward entailing alright, but that this is not directly reflected in the truth conditions of sentences like (103) - (105) because the objects do not enter this local context: due to the type mismatch used to explain away the unattested unspecific reading (cf. Section 3.2 above), the object flees to an upward monotone position above the predicate, leaving a bound variable, its trace, in the downward monotone environment. Still, the the story goes, it is the monotonicity properties of the local context that are decisive for *NPI*-licensing.

Obviously, such an explanation of the data in (106) – (107) would be at odds with an exact match analysis of *seek*, which predicts non-monotonicity in the object position. And we have seen (at the end of Section 3.3) that the success-oriented analysis was problematic precisely because of its downward monotonicity. Moreover, the object position of transitive *prevent* does not appear to be downward monotone either; within the present framework, the following lexical analysis of *prevent* yields adequate truth conditions:[78]

(110) *Lexical Analysis of* prevent
For any property P, individual x, world w, and time t, the following holds:
$[\![\text{prevent}']\!]\,(P)\,(x)\,(w,t) = 1$ iff there is an act ε performed by x in w at t such that the following two conditions hold:

(*a*) the extension of P in w at t is empty;

(*b*) the extension of P in w' at t is non-empty for any w' that minimally differs from w in that x does not perform ε in w' at t.

Condition *(b)* expresses a causal dependence between the non-existence of certain objects and the subject's unspecified act in terms of a common reconstruction of counterfactuality:[79] according to (110) and the present analysis, (103) says that, had it not been for some activity of Jones's, a fire disaster would have occurred. This looks correct. If so, the object position of *prevent* is not downward monotone. To see this, one may consider Jones who has prevented a fire disaster by closing the windows and extinguishing the flames in time. Had he not done that,

77 Ladusaw (1979).
78 Something similar to conditions *(a)* and *(b)* in (110) has been proposed in Condoravdi *et al.* (2001a: 167; 171f.) as part of the truth conditions.
79 Stalnaker (1968), Lewis (1973).

a fire disaster would have happened that would have killed between 1 and 10 persons. Hence Jones stands in the relation characterized in (110) to the property F of being a fire disaster. And maybe he also stands in that relation to the properties K_1 and K_{10} of being a fire disaster that kills one person and 10 persons, respectively. To be sure $K_1 \sqsubseteq F$ and $K_{10} \sqsubseteq F$. But then we also have $K_{110} \sqsubseteq F$ even though a fire disaster killing 110 persons would not have ensued had Jones acted less prudently. Hence there is a sub-property of F to which Jones does not stand in the relation expressed by *prevent* according to (110). Consequently, given (110), *prevent* does not create downward monotonicity.

On the other hand, (106) and (107) show that its direct object position does license *NPI*s. Maybe, then, a slightly weaker criterion for licensing *NPI*s is called for. In fact, (110) suggests that *implying* (non-trivial) downward monotonicity is enough.[80] More precisely, let us call a non-empty set $\mathfrak{A}$ of properties (corresponding to a context in which a property-denoting expression may occur) *negative* if there is a non-trivial downward monotone set $\mathfrak{A}^*$ such that $\mathfrak{A} \subseteq \mathfrak{A}^*$.[81] Then according to (110), the object position of *prevent* is obviously negative, the conjunct *(a)* alone determining the relevant superset. Moreover, it turns out that according to the exact match analysis (61), the object position of *seek* is negative too, which might explain the grammaticality of (108) and (109).

I can see two problems with this explanation. For one thing, it would be odd that *NPI*s should be licensed by the position of their traces. This is not what is going on in general:

(111) Mary did not refuse to read any particular book [but books in general].
(112) Mary refused to read any particular book.

In (111) the *NPI* quantifier may – in fact, most likely does – take intermediate scope, binding a trace in the downward monotone context created by *refuse*. However, not the latter but the negation is its licenser. Otherwise one may expect it to be able to obtain maximal scope; but certainly no such specific reading is available for (111). In any case, (112) does not have a specific reading, apparently because it would have the *NPI* outside its licensing context, even though its trace would remain there.

Moreover, an explanation of the grammaticality of (106) – (108) in terms of negativity is likely to overgenerate. For certainly not all opaque verbs host *NPI*s:

(113) ?He owes her the slightest excuse.
(114) ?She owes him any beer.

To account for these data, one would have to analyze *owe* as not creating a negative context:

(115) *Quine + Hintikka Analysis of* owe
For any property P, world w, time t, and individuals x and z the following holds:
$[\![\text{owe}']\!]\,(z)\,(P)\,(x)\,(w,t) = 1$ iff there is an obligation ω that x has in w at t such that for all worlds w' and times t' where and when ω is fulfilled, there is an individual y given to z by x at t' in w' such that $P(y)(w',t') = 1$.

According to (115), the direct object position of *owe* is upward monotone and thus not negative, as required. Apart from the additional argument corresponding to the indirect object,[82] (115)

[80] Condoravdi *et al.* (2001a) seem to conflate the two criteria, ultimately relying on negativity (as I will call it) in *lieu* of downward monotonicity, which is why I go into this explanation in detail.

[81] In the case of unary (non-empty) quantifiers negativity boils down to not accepting the universe. In particular, then, no upward monotone quantifier is negative whilst all non-trivial downward monotone quantifiers are. These observations come in handy in determining the negativity of a given environment, as in the cases below.

[82] According to (115), the indirect object of *owe* is transparent. The analysis could be easily adapted so as to accommodate to opacity if need be. As noted in Section 1.3 of Zimmermann (to appear), there appears to some dialectal variation in this respect. More variation occurs as to the admissibility of specific readings of the direct object of *owe*; see Section 6.1 of

closely resembles the Quine + Hintikka analysis (62a) of *seek* given in Section 3.4. And it is plagued with the Monotonicity Problem, subsuming any two distinct debts under one common obligation, as the reader is kindly invited to verify:

(CO') *x* owes *z* a *P*.
y owes z' a *Q*.
∴ *x* owes *z* something *y* owes z'.

As in the case of *seek*, a variation of the Quine+Hintikka analysis is called for to avoid such fallacies:

(116) *Perfect Match Analysis of* owe
For any property *P*, world *w*, time *t*, and individuals *x* and *z* the following holds:
$[\![\text{owe}']\!]\,(z)\,(P)\,(x)\,(w,t) = 1$ iff there is an obligation ω that *x* has in *w* at *t* such that for all worlds *w'* and times *t'* it holds that ω is fulfilled in *w'* at *t'* iff there is an individual *y* given to *z* by *x* at *t'* in *w'* such that $P(y)(w',t') = 1$.

However, the direct object position according to (116) is just as negative as the one predicted by (62a). In fact, upward monotonicity – and thus the Monotonicity Problem – can only be escaped at the price of installing negativity.[83] I thus take it that (116), though sketchy and not entirely accurate[84], is closer to the truth than (115). If so, the direct object position of *owe* is negative, thus destroying any hope of explaining the oddity of (113) and (114) along the above lines. An alternative explanation of these facts might be found by analyzing the alleged *NPI*s in (106) – (109) as (wide scope) universal quantifications over properties, thus modifying a classical analysis of *any*[85] and generalizing it to other cases of negative polarity. The inadequacy of (113) and (114) would then come out expressing extremely unlikely (though not impossible) propositions. This would also explain why *NPI*s that cannot be analyzed as universal quantifiers are less acceptable in the environments under scrutiny:

(117) ?This device prevents any movement at all.
(118) ?The police are looking for any witnesses at all.

I will not follow up this speculation here, leaving the matter for future research.

5.3 Coordinated Objects

The following inference from non-specifically read premisses is easily captured, provided that *and* is assigned a straightforward type-shifted interpretation, as in (120).

(119) Jones is looking for a candle.
Jones is looking for a match.
∴ Jones is looking for a candle and a match.

(120) $\text{and}' = \lambda\Sigma_{qt}\,\lambda\Pi_{qt}\,\lambda\mathcal{Q}_q\,[\Sigma(\mathcal{Q}) \wedge \Pi(\mathcal{Q})]$

Given (120), the conclusion of (119) comes out as equivalent to the conjunction (121) of the two premisses, as the reader may care to verify. It should be noted that (121) does not say that Jones is engaged in a single search for two objects, which may be rendered as (122), if we avail ourselves of the lexical decomposition of *seek*:

(121) $[\,(\exists P)\,[P \sqsubseteq \text{candle}' \wedge \text{seek}'(\text{Jones}',P)] \wedge (\exists Q)\,[Q \sqsubseteq \text{match}' \wedge \text{seek}'(\text{Jones}',Q)]\,]$
[≡ $[\,(\exists P)\;[P \sqsubseteq \text{candle}' \wedge \text{try}'(\text{Jones}',(\exists y)\,[\,P(y) \wedge \text{find}'(\text{Jones}',y))] \wedge$
$(\exists Q)\,[Q \sqsubseteq \text{match}' \wedge \text{try}'(\text{Jones}',(\exists z)\,[\,Q(z) \wedge \text{find}'(\text{Jones}',z))]\;]$]

Zimmermann (to appear) for some discussion.

83 Note that, in view of the observations made in fn. 81, the reversal is not true: any non-monotonic quantifier that accepts the universe is non-negative.

84 That (116) cannot be the whole story about owing follows from a neat observation made by Ron Artstein (p.c., 2000): a bank clerk might have an obligation to give me a certain sum without actually owing it to me.

85 Reichenbach (1947: 105ff.).

(122) $(\exists P)\ (\exists Q)\ [P \sqsubseteq \text{candle}' \wedge Q \sqsubseteq \text{match}' \wedge$
$\text{try}'(\text{Jones}', [(\exists y)\ [P(y) \wedge \text{find}'(\text{Jones}',y)] \wedge (\exists z)\ [Q(z) \wedge \text{find}'(\text{Jones}',z)]])]$

According to the present analysis, (121) is true if Jones is both engaged in a search ε that is successful just in case he finds some particular kind of candle, and in a search ε' that is successful iff he finds a particular kind of match. Since the possibility of finding only one of the desired objects cannot be excluded, either of ε and ε' may be successful without the other one; in particular, then, $\varepsilon \neq \varepsilon'$. According to the perfect match analysis (61) of *seek*, (122) is true if Jones is performing a search act ε" that is successful just in case he finds both a candle and a match. Since there are possible situations in which he finds only one of the desired objects, either of ε and ε' may be successful without ε" being successful; in particular, then, $\varepsilon' \neq \varepsilon'' \neq \varepsilon$. So the truth of the premisses in (119) does not by itself guarantee the truth of (122). In order to achieve that effect, one would need the background assumption that the two distinct searches Jones is engaged in according to the premisses add up to one combined search he performs. The principles governing such cumulations of searches depend on the exact nature of the underlying event ontology with which I do not want to concern myself here. But even if (122) can be shown to follow from (121), it is by no means obvious that it also constitutes a separate reading of the conclusion of (119). Though technically implementable once the eventuality parameter is allowed to occur in logical forms (and not just in spelt out lexical entries as I have been assuming for simplicity), such a reading would create problems when it comes to the inverses of (119):

(123a) <u>Jones is looking for a candle and a match.</u>
∴ Jones is looking for a candle.

(b) <u>Jones is looking for a candle and a match.</u>
∴ Jones is looking for a match.

These inferences look as cogent as (119). And they come out on the reading (121) of the premiss (and an underspecific reading of the conclusions); obviously they also come out valid on a double specific reading (with a specific conclusion), as well as on various mixed readings (with varying conclusions). This seems right: there is no way of understanding the premiss that does not imply each conclusion (on at least one reading). However, (122) does not imply any them (on any reading): if Jones's search is only successful in case he finds both a candle and match, then he does not have to be engaged in a search that is successful just in case he finds some particular kind of candle. And this time no general assumptions about the structure of events will turn the *non sequitur* into a valid inference. For the general pattern (124) underlying (123) contradicts the perfect match analysis. More precisely, if we attribute to the schema (124) a reading (124'), then that reading only satisfies the inference pattern (125) on the monotonicity condition (126):

(124) x is looking for a P and a Q.
(124') $[(\exists P')\ (\exists Q')\ [P' \sqsubseteq P \wedge Q' \sqsubseteq Q \wedge \text{try}'(x, (\exists y)\ (\exists z)\ [\ P'(y) \wedge Q'(z) \wedge \text{find}'(x,y) \wedge \text{find}'(x,z))\ ]$

(125a) <u>x is looking for a P and a Q.</u>
∴ x is looking for a P.

(b) <u>x is looking for a P and a Q.</u>
∴ x is looking for a Q.

(126) $(\forall x)\ (\forall P)\ (\forall Q)\ [[P \sqsubseteq Q \wedge \text{seek}'(x,P)] \rightarrow \text{seek}'(x,Q)]$

Given a reading (124') of the premiss, the pattern (125) taken in its full generality, implies (126). For if x stands in the relation seek' to $P \sqsubseteq Q$, then any situation in which x finds a (particular kind of) P will be situation in which x finds a particular kind of Q; hence (124') is true, and thus, by (125b), x would thus also stand in the relation seek' to Q. Obviously the, argument turns on the possibility of instantiating P and Q by the same individual y found by x. So the following revision of (124') suggests itself as a possible reading of (124) that does report the subject to be engaged in a single search:

(124") $[(\exists P')\ (\exists Q')\ [P' \sqsubseteq P \wedge Q' \sqsubseteq Q \wedge$
$\text{try}'(x, (\exists y)\ (\exists z)\ [\ P'(y) \wedge Q'(z) \underline{\wedge\ x \neq y} \wedge \text{find}'(x,y) \wedge \text{find}'(x,z))\ ]$

The difference between the two purported readings of (124) lies in the underlined conjunct: according to the (124"), subject *x* is after finding two *distinct* objects. I see know reason why such a reading should not be in accordance with the perfect match analysis. In fact, I suspect that it would come out of a thorough treatment of (possibly non-Boolean) plural conjunction.[86] But I cannot go into these matters here. Suffice it to say that no scoping mechanism for the event parameter would be needed in order to derive (124") as based on a plural reading of the conjoined object in (124).

Yet another reading of conjunctively coordinated objects becomes available when their head nouns express compatible properties:

(127) Jones is looking for a companion and a lover.
(128) Smith is looking for a good restaurant, and a cheap one.

(127) and (128) each can be understood as reporting Jones to be looking for just one individual – someone who would be both a companion and a lover, and a cheap restaurant, respectively. It is not obvious how to derive these readings. Maybe the conjunction applies to the existentially lowered conjuncts, which are then property-lifted; however, existential quantification would still have to be added by yet another type shift. The same combination could help explain the ambiguity in:

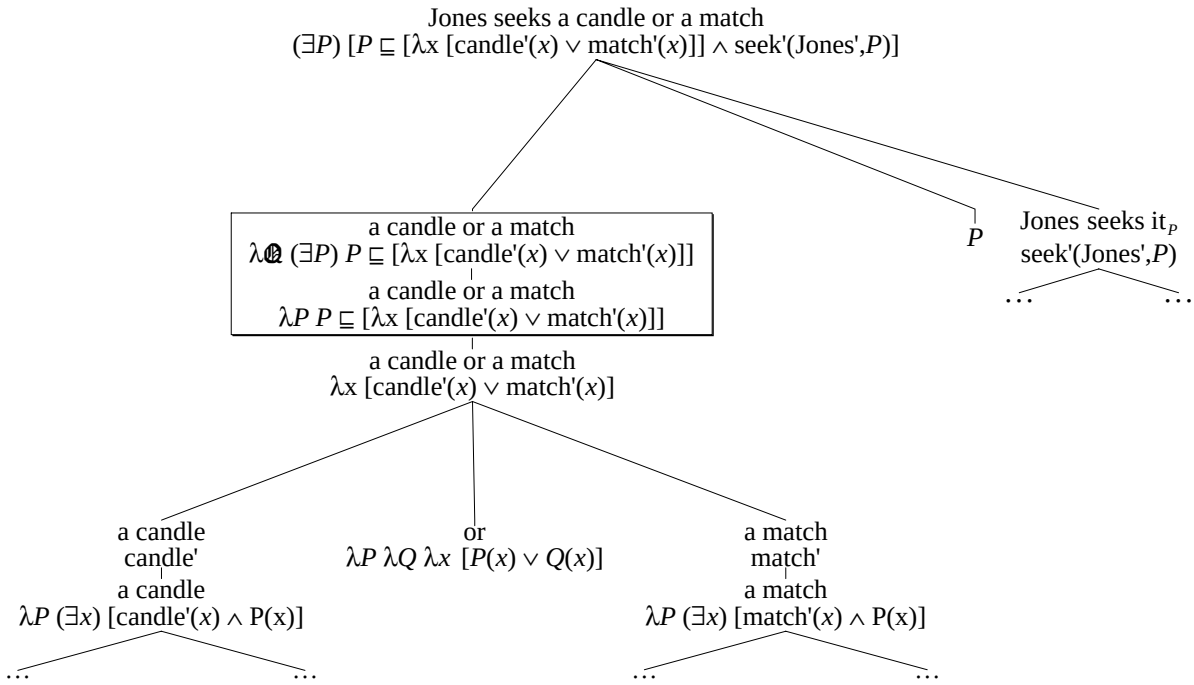
(129) Jones is looking for a candle or a match.

On one construal, (129) is equivalent to (130), which could be accounted in terms of a disjunctive analogue (120):[87]

(130) Jones is looking for a candle or Jones is looking for a match.

However, (129) may also be understood as reporting a single search activity of Jones's, one that successfully terminates once Jones has found a particular kind of candle or a particular kind of match. This reading is not easily captured on the current approach; but it may be covered by the combination of type shifts just indicated:

(131)



86 I suppose the (non-) Booleanity of plural conjunction, addressed in Winter (2001), is orthogonal to the present problem. In any case, there would have to be some *proviso* to ensure the distinctness of the denotations of the conjuncts.

87 As noted in Partee & Rooth (1983), this reading is not derivable in the classical approach of Montague (1973), which has no problem in predicting the one in (131) below.

The highlighted part makes use of an otherwise unnessary and possibly overgenerating operation of Existential Closure. Moreover, (131) also involves the equally dubious operation of Existential Lowering (46), discussed and dismissed in Section 3.2 above. Another reason why (131) may arouse suspicion is that it is implied by either of its disjuncts. While this may be explained away by familiar Gricean reasoning, the impression that the purported implicature is virtually impossible to cancel is not so easily dismissed. A non-Boolean interpretation of *or* thus seems to fare better here.[88] Though the details of such an approach are certainly delicate, the following remarks should indicate that it is not so wide of the mark. The idea is to interpret *or* as presenting a conjunctive list of alternatives within an idependently given space:

(132) $\text{or}' = \lambda p_t\, \lambda q_t\, \lambda \Gamma_{tt}\, (\exists p')\, (\exists q')$
$[\, \Box\, [p' \rightarrow p] \wedge \Box\, [q' \rightarrow q] \wedge \Diamond p' \wedge \Diamond p' \wedge \neg \Diamond\, [p' \wedge q'] \wedge \Box\, [\, \mathscr{B}_\Gamma \leftrightarrow [p' \vee q']\,]$

According to (132), (binary) clausal *or* combines the two propositions expressed by the disjuncts with a sentential operator, which may be expressed overtly or else left implicitly epistemic. The entire *ensemble* expresses that the *base* of the operator, i.e. the set of worlds it quantifies over,[89] can be (bi-) partitioned in a way that each the disjunct is implied by one of the cells. Without going into the general motivation behind (132), let me directly type-adapt it to make it applicable to cases like (129):

(133) $\text{or}' = \lambda \Sigma_{qt}\, \lambda \Pi_{qt}\, \lambda \Gamma_{(et)t}\, (\exists P' \sqsubseteq P)\, (\exists Q' \sqsubseteq Q)\, [\, \Diamond\, (\exists x)\, P'(x) \wedge \Diamond\, (\exists x)\, Q(x) \wedge$
$\neg \Diamond\, (\exists x)\, [P'(x) \wedge Q'(x)] \wedge \Box\, (\forall x)\, [\, \mathscr{B}_\Gamma(x) \leftrightarrow [P'(x) \vee Q'(x)]\,]$

With (133), the higher-order readings of the disjuncts in (129) may be directly coordinated and quantified into the matrix *John is looking for P*. Under the assumption that the base of the matrix is *maximal* in the sense of (80) in Section 4.2, (129) then comes out as:[90]

(134) $(\exists P' \sqsubseteq \text{match}')\, (\exists Q' \sqsubseteq \text{candle}')\, [\, \Diamond\, (\exists x)\, P'(x) \wedge \Diamond\, (\exists x)\, Q'(x) \wedge$
$\neg \Diamond\, (\exists x)\, [P'(x) \wedge Q'(x)] \wedge max_P\, \text{seek}'(\text{Jones}', P) \sqsubseteq \lambda x\, [P'(x) \vee Q'(x)]]$

The formula roughly says that being an intended object of Jones's search amounts to being either a special kind of candle or a special kind of match. This looks adequate. Moroever, given the non-emptiness constraints on the disjuncts – typical of the modal approach to disjunction – the unintuitive inference from the disjuncts to the disjunction is blocked. I hope that these remarks suffice to convince the reader that the non-Boolean approach to (129) is worthy of further exploration – but not here and now.

5.4 Comparative Remarks

In order to see how the present approach to opacity relates to its predecessors,[91] it is instructive to classify them according to the following three criteria:

- *Readings*

Any theory I am aware of sharply distinguishes Specific and non-specific readings; only one allows for a reading that is Neutral between the two. As to non-specificity, there are basically two different approaches, which may be distinguished in terms of functor/ argument structure: as indicated in Section 0, one may think of the verb as either having a non-standard denotation of which it Predicates something, or else as Quantifying over non-standard objects. Virtually no theory allows for both possibilites.[92]

88 Forbes (2003: 60ff.) arrives at a similar conclusion, tracing back the idea of non-Boolean *or* to Makinson (1984); the following sketch is based on Geurts (to appear), a derivative of Zimmermann (2000); I have made several simplifications for presentational reasons.

89 If the operator happens to be a standard modality, its base should coincide with the *modal base* in the sense of Kratzer (1991). In general a canonical definition of *base* may be given in terms of generalized quantifier theory. For instance, the notion of a *main base* as defined in Lerner & Zimmermann (1983: 295) may be adapted.

90 If the base is determined as indicated in the previous footnote, one needs assume that the intended object of search is unique, i.e. that at the success indices Jones only finds one object.

91 See Forbes (2004) for a survey.

- *Argument Type*

Apart from periphrastic approaches (for which this point is pointless), all theories treat opaque verbs as expressing relations. They differ as to what kinds of objects the subjects are related to. The present approach has *p*roperties where others have *q*uantifiers or both. And there is also the Meinongian tradition that has other kinds of (mostly) *a*bstract objects instead.

- *Monotonicity*

The relation expressed by the verb may or may not be monotone. Many previous approaches are silent on this matter, but some give meaning postulates or specify denotations to decide the matter. According to some theories, monotonicity properties depend on the verb.

Table 4 compares some previous approaches to the present one in the above terms:

loci	readings	arg. type	monotonicity		
			⇑	⇓	⇔
Quine (1956; 1960); Larson *et al.* (1999)	P, S	–			
Montague (1969; 1970; 1973)	P, S	*q*			
Zalta (1988); May (1985)	Q, S	*a*			
Zimmermann (1993); McNally & van Geenhoven (to appear)	P, S	*p*	*seek*, *want*		*resemble*
Moltmann (1997)	P, S	*q*/*p*	*seek*, *need*		
Condoravdi *et al.* (2001a; b)	P, Q, S	*p*		*prevent*	–
Forbes (2003)	P, Q, N, S	*q*		*need*, *lack*	
hic	Q, S	*p*	–	–	*seek*, *owe*, *prevent*

Table 4: Comparing theories of opacity

Final Note

Part of the material in this paper was presented at a workshop on *Intensionality* at the *14th European Summer School in Natural Language Processing, Logic and Knowledge Representation (ESSLLI)* in Trento (August 2002), as a colloquium talk in the department of philosophy at the University of Texas at Austin (October 2002), at a workshop on *The Notion of an Object* at Reid Hall in Paris (May 2003), at a workshop on *Specificity* at the 15th *ESSLLI* in Vienna (August 2003), at a lunchtime talk in the Computer Science Department at Trinity College Dublin (March 2004), and in the semantics colloquium at the University of Nijmegen (May 2004). The Monotonicity Problem was already mentioned in Section 2.2 of Zimmermann (to appear). For its solution I owe a great debt to suggestions independently made by Josh Dever and Tim Fernando. Discussions with the following friends and colleagues also greatly helped to improve the content of this paper: Nicholas Asher, Heinrich Beck, Daniel Büring, Cleo Condoravdi, Martin Emms, Graeme Forbes, Hans-Martin Gärtner, Veerle van Geenhoven, Bart Geurts, Anthony Gillies, Alex Grosu, Helen de Hoop, Fred Hoyt, Hans Kamp, Shin-Sook Kim, Cécile Meier, Friederike Moltmann, Yiannis Moschovakis, Nikolaj Oldager, Christian Plunze, Uli Sauerland, Magda Schwager (*née* Scheiner), David Sosa, Arnim von Stechow, Roberto Zamparelli, Henk Zeevat, Malte Zimmermann, and Sandro Zucchi.

92 Parsons (1980: 47f.) is an exception, but I have not listed that approach because it is not primarily a theory of opacity in the sense envisaged here.

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